INTRODUCTORY PHYSIOLOGY AND HYGIENE

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INTRODUCTORY

PHYSIOLOGY AND HYGIENE

FOR USE IN PRIMARY GRADES

BY

H. W. CONN, PH.D.

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PREFACE

THIS introductory text-book on physiology and hygiene is, as its title indicates, intended to precede the author's more advanced work on the same subject. The demand for a beginner's book, to be used in primary grades, has been urgent, owing to the steadily increasing recognition, on the part of both parents and teachers, of the necessity of instilling in children, even when very young, an appreciation of the laws of health.

The aim of this little book is not only to instruct, but to interest, its readers by presenting the subject in simple language and by using only such comparisons as are familiar to the average child. Special emphasis has been laid on the value of good food, of out-of-door exercise, of the formation of regular habits, and of right living from day to day.

As in the elementary book, the effect of alcohol and narcotics is treated in direct connection with the various organs and functions of the body concerned.

The illustrations have been carefully selected with a view toward helping pupils to understand the text and toward stimulating them to healthful activity.

The author is especially indebted to the Young Men's Christian Association of New York City for their courtesy in allowing the reproduction of several illustrations of their outdoor games and sports.

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INTRODUCTORY PHYSIOLOGY AND HYGIENE

CHAPTER I

WHY WE NEED TO KNOW ABOUT OUR BODIES

The Steam Engine and How It Moves. — A railroad engine stood attached to a train in the train-yard. It was a wonderful piece of machinery. It had a great boiler and driving wheels as high as a man's head. Yet all its wheels could not make the engine move itself, so there it stood, as helpless as a lump of clay.

Two men came up — the fireman and the engineer. The fireman made a fire in the furnace of the engine and fed it with fuel. He also cleaned and oiled the machinery. The water in the boiler grew hot, and part of it became steam. When steam enough had formed, the engineer opened the throttle and "turned the steam on." Through the force of the steam the engine started smoothly and swiftly down the track.

The engine may draw its train many hundred miles every day. To do this the machinery must

be kept clean and well oiled. The fireman must see that there is plenty of water in the boiler and plenty of coal or other fuel in the fire box. There must be a skillful engineer, who knows every part of his engine, as you know your letters, and who can run his engine so that the passengers on the train are safe.

A Model Locomotive

The Body Engine and How It Works. —The human body also is a wonderful engine. Its machinery is far more delicate than that in a locomotive. Every one must be the engineer of his own body, and its fireman also. If we keep our body engines in good order, they will do their work well. If we let them get out of order, they cannot work as they should, and we may suffer *pain*. A person whose body is out of order is *ill*.

An engineer does not know how to run an engine without learning about its machinery and how the machinery works. Likewise, if we wish to keep well and strong, we should learn about the body engine and how its machinery works. The study of the body and its works is called *Physiology.*

The engineer, as we have seen, must not only understand his engine, but learn how to keep it in perfect order. If he does not, the machinery may become so clogged and broken that it cannot work. We, too, must learn how to care properly for our bodies. The study of the way to take care of the body is called *Hygiene.*

What is going on in our Bodies. Food and its Uses. — Every little while the railroad engine must have more fuel. If the fireman does not frequently give the furnace the fuel it needs, the engineer will find that his locomotive will go more and more slowly and will finally come to a stop.

Our bodies need something that corresponds to fuel. Every day they let us know that there is something they need by making us feel hungry.

The engine must have proper fuel to burn or it cannot work. Our bodies must have proper food or we cannot be well and do *our* work.

If we treat our bodies well, we may be healthy all our lives. The engineer is proud of having his engine in the best possible order. The parts of the machinery must move easily; the metal must shine, and no unsightly dirt or dust must mar the appearance of his beautiful locomotive. We, too, should be proud to keep our bodies beautiful, by living so that they may be pure, clean, and healthy, without and within.

QUESTIONS

1. What does the engine need to make it move?
2. What will happen if the engine has no water or coal?
3. Who guides the engine?
4. What is the engine that you must guide?
5. What will happen to the body engine if it is not guided well?
6. What would you have to do before you could guide a locomotive?
7. What must you do to be able to guide your body engine?
8. What is the study by which we learn how to care for our bodies?
9. What is the study by which we learn about the different parts of the body and how they work?

CHAPTER II

WHY WE NEED FOOD

THE baby cries for its breakfast. The dog barks for his bone. A cat will watch at a mouse-hole for hours at a time. The robin searches the lawn for worms in the early morning or pecks at the cherries in the orchard. The plants take food from the soil in which they grow. Everything that lives must have food — the kind of food it needs — or it will die.

Three times a day, perhaps oftener, we are hungry. This means, as we have already seen, that the body is calling for food to supply its needs.

You came into the world a tiny baby. Your fingers were so small that you could not even hold a rattle. Your feet were so weak that you could not take a step. Now you are tall and strong. You can lift a flatiron or a heavy stone, and your feet and legs carry you wherever you wish to go. Some day you expect to be larger still, as large as your father or your mother.

Why we need Building-food. — Your growing from a baby to a man is due to the food you eat. Children must have a large amount of food to make their bodies grow. Even grown-up people must eat some building-food, for, though they are not getting taller, parts of the skin, the muscles, the bones, and indeed all parts of the body wear out. You have, perhaps, seen bits of loose skin hanging from your hand. This was worn-out skin thrown off by the new skin which grew underneath. When our clothing wears out, it has to be mended or repaired. When parts of our bodies wear out, they also must be repaired. So food that builds up our bodies is also needed to repair them when they are wearing out.

Why we need Food for Power. — When you lift your arm, the muscles do the lifting. It is the food we eat every day that gives them the power to move. A locomotive may stand still in the engine house all day long and need no coal while it is there. When our bodies are lying still, they need very little food, but since, when we are awake, they are really always moving, they must have food all the time. Even when we are asleep

we are breathing, and the heart is always beating to pump the blood through the body. Both the breathing and the beating take power.

Boys work and play out of doors nearly all day, except when they are in school. Girls take

"Boys and Girls come out to Play."

less exercise. They spend more time in the house, playing with dolls or helping mother. Which needs more food, a boy or a girl? Why?

Why we need Food for Warmth. — Besides food for growth and repair and food for power, the body needs also food for warmth.

If, with your bare hand, you happen to pick up a stone that has been lying on the ground on a wintry day, you will find it very cold. You yourself may have been exposed to the same wintry weather, but, if you have been playing, your body is really just about as warm as when you are in the house. A stone becomes cold if the air is cold, because there is nothing inside it to keep it warm. Our bodies, on the other hand, are always warm. If they were not, we should die.

To keep a house warm, we burn coal in the stove or furnace. Part of the food we eat is burned in the body to keep us warm. The food you ate to-day and yesterday keeps you warm, even though you are out in the cold air. As the body needs much warmth in winter to overcome the cold air, we need to eat more nourishing food in winter than in summer.

We need food, then, for three purposes — to make our bodies grow, to keep our muscles strong and give them power to move, and to furnish warmth for our bodies.

Building-foods. — Is there a baby at your house? If so, you know how fast it grows. You can see

a change almost from day to day, yet the baby eats nothing but milk until it is several months old. Milk makes babies grow, furnishes their muscles with power, and keeps their bodies warm at the same time. Little babies need only milk for building-food, but by the time they are old enough to walk, they ought to have other things as well.

THE OAT PLANT

Very likely mother begins by giving baby a little oatmeal with his milk. Oatmeal is one of the best sorts of foods for growth. All foods, like oatmeal or cracked wheat — cereals, we call them, — are building-foods. They also give us power and keep us warm.

By the time baby is a year old, he can eat some bread and butter. The bread helps him to get strong and stout; the butter keeps him warm.

Lean meat, milk, beans, and peas, all are good building foods, that is, they help us to grow. They all give power to the muscles, too, and all have warming qualities.

Food for Power and Warmth. — We eat some kinds of food that do not build our bodies at all. They do nothing but give us power and keep us warm. Sugar is one of these. If we should eat candy or sugar all the time, it would never make us grow one inch taller, nor would it even keep us alive. We eat sugar to give our muscles power to move and to keep us warm. Fat meat, cream, or any food that contains oil or starch also gives us power and warmth. Bread, potatoes and nearly all vegetables are partly starch, and, when cooked, starch is a good food to furnish power and keep us warm.

Fat is the best of warming food and likewise furnishes us with power for our muscles. We need very little fat in summer because our bodies would get too warm, and we should suffer with the heat. In winter we should eat more fat than in summer so that our bodies will not suffer from the cold. The children who live in the far-

away north eat a great deal of fat. An Eskimo boy or girl would rather eat a tallow candle as a treat than a box of the nicest candy.

So, if we should go on through the whole list of foods, we should find that each does something for our bodies. We learn in *Physiology* just what kinds of food it is best for us to eat to build our bodies, and what kinds are best to give us power, and to keep us warm.

QUESTIONS

1. How do we know when a dog needs food? A cat?
2. How do we know when we need food?
3. For what three purposes do we need food?
4. Why must our bodies have food several times a day?
5. When do you eat more, in summer or in winter? Why?
6. What can you eat to make you grow?
7. What can you eat that will give your muscles power and keep you warm?

WRITTEN LESSON

1. Make a list of ten kinds of food you like to eat in summer. Are they the best foods for you to eat in hot weather?
2. Make a list of ten different kinds of food you like to eat in winter. Are they the best foods for you to eat in cold weather?

CHAPTER III

WHAT TO EAT

If you should sit down to a table every day for a week and have nothing given you but oatmeal, you would think you were badly treated. You might eat enough of it to keep you from starving, but you would soon become so tired of it that you would probably lose all desire for food.

The desire for food is called the *appetite.* To keep a healthy appetite, we must have not only plenty of foods for building the body, for giving it power and for keeping it warm, but we must have a variety of each kind of food.

Foods that are Good for Us. — We should have for every meal some food to furnish building material and some to supply power and heat. Children should eat bread and butter, milk, a little meat, and cereals. Milk builds and repairs our bodies and also gives them power and warmth. Cereals, as you already know, are also a good building-food. The cream of the milk, the butter that is

eaten on the bread, and the meat will supply us with fat. What does fat do for our bodies?

We should also eat some sugar to give us power and keep us warm. Candies and cakes will supply the needed sweet. We should not eat very much cake, because it fills up the stomach and gives us only a little building-food. Candy is a perfectly proper food if it is eaten at mealtime. It is very bad for the stomach if a person munches candy all the time.

Breakfast, Dinner, and Supper. — Have you ever thought why we have several different kinds of food at a single meal? If we should eat only building-foods, our appetite would soon grow tired of them and demand other kinds of food also — that is, foods for power and warmth. So, for breakfast, we may have oatmeal and milk, eggs, or a small piece of meat, and fruit. For dinner we have something more substantial, like soup, meat and potatoes, bread and butter, and afterwards a sweet dessert. The meat, potatoes, and bread give us building-food as well as power and warmth. The butter and dessert furnish power and warmth, but very little building-food.

As a rule, children who have dinner at noon enjoy better health than children who have dinner at night. If a hearty meal is eaten at night, it would be better for children not to go to bed for an hour after eating. Then they will have a

SUPPER TIME

chance to exercise and will sleep better for it.

A good supper for a child is bread and butter, milk, stewed fruit, and plain cake.

School Luncheons. — A school luncheon should be very simple. If the luncheon is to be eaten at

recess, take a slice of bread and butter and some fruit. For noon luncheon, sandwiches are good, and plain cake.

Sandwiches may be made in as many ways as there are school days in a month. Peanut butter, sardines, chopped ham and slices of cold meat, all make a good filling. Wrap the sandwiches in one piece of paraffin or waxed paper, the cake in another, the fruit in still another. A school luncheon tastes better when it is daintily put up.

QUESTIONS

1. What would happen if you had nothing to eat but oatmeal?
2. What is appetite?
3. What can you eat that will furnish your body with building food? With power?
4. What kind of food furnishes you with the most warmth?
5. Why do we have a variety of foods at every meal?
6. Is it better for children to have dinner at night or at noon?

WRITTEN LESSON

1. Write a list of foods that would make a good, nourishing breakfast.
2. Write another, telling what foods would make a good dinner.
3. Write a third list, telling what you had for supper last night.

CHAPTER IV

KINDS OF FOODS

The Three Kingdoms. — Probably many of you have played the game of "Twenty Questions." If you have, you will remember that the first question is, "Does it belong to the animal, mineral, or vegetable kingdom?"

Everything in the world must belong to one of these three classes or kingdoms. Let us see to which of these kingdoms certain different kinds of food belong.

TABLE OF PRINCIPAL FOODS

Animal	*Mineral*	*Vegetable*
Milk	Salt	Cereals
Butter	Lime	Vegetables
Eggs	Soda	Fruit
Flesh	Iron	Nuts
	Potash	Sugar
		Spices
		Honey

By *flesh* we mean meat, fowl or game, and fish. The best kinds of meat for us to eat are *beef* and *mutton; chicken* also is very good.

We all need *lime* to make bones and to keep them hard and strong. All the lime our bodies need we may get from cereals and in bread and milk. *Soda*, *potash*, and *iron* are all necessary for our health and are contained in several of the different kinds of food that we eat.

You have, perhaps, heard the old question, "What is it that spoils the potato when it is left out?" We like sugar with some kinds of food, pepper with others. There is one thing that we want with all kinds of cooked food. We sometimes sprinkle a little *salt* even upon nuts. We do not get food for growth, power, or warmth from salt, and yet our bodies need to have a little of it in order to be healthy.

The most nourishing vegetables are *beans* and *peas*. *Potatoes* contain a great deal of starch, as you have already learned, and are therefore a good food for furnishing power and warmth.

Fruits should be eaten only when they are *ripe*, unless they are stewed.

Nuts are a nourishing food, if eaten slowly and chewed *very fine.* Honey, too, is good for us in small quantities, but *spices* are often very harmful. They may make food taste better, but if eaten too freely, they injure the stomach.

Perhaps, when you are studying the table of foods, you will wonder why bread and jelly and cake, and many other foods, are not given. Study the table very carefully again, and this time you will notice that only *raw* foods are given.

Now bread, which is a cooked food, contains flour and milk and a little salt and sugar. The flour, which is made from wheat or grain, and the sugar are *vegetable* products. The milk is an *animal* product and the salt is a *mineral* product. So bread belongs to all three kingdoms.

QUESTIONS

1. What are the names of the three kingdoms?
2. Name the principal animal foods. The principal mineral foods. The principal vegetable foods.
3. What do we mean by flesh?
4. What parts of our bodies need lime? Why?
5. Which mineral food is the most needed to keep our bodies healthy?
6. To what kingdoms does candy belong? Cake? Jelly?

CHAPTER V

WHY WE NEED DRINK

THE blood flows through our bodies constantly. The blood is a liquid and contains a large amount of water. So we must drink enough water to give the blood all it needs.

A SOURCE OF GOOD DRINKING WATER

On a warm day our hands become moist, and sometimes little drops of moisture stand out on our faces. This moisture, called *sweat*, is moisture that comes from inside the body through the skin. Water is passing out through little openings in the skin all the time; but we see it only when we are very warm, for then it comes faster than usual. We must drink water to give our bodies the moisture they need to send out through the skin.

The bones and muscles of our bodies also need water. In fact, about three fourths of the weight of the human body is water. Much of the water that we need we get in the different foods we eat. Some foods are cooked with water, and other foods have water in them. The juice of fruit is water, and so is the juice of meat. Milk also contains a great deal of water. But our bodies need more water than they can get through the food we eat. We must also drink water. The desire for water we call *thirst.*

QUESTIONS

1. Why do our bodies need water?
2. What is sweat?
3. How much do you weigh? How much of the weight of your body is water?
4. If there were no water in your body, how much would you weigh?
5. Do our bodies get water in other ways than through the liquids which we drink?
6. What is thirst?

CHAPTER VI

WHAT TO DRINK

What is Best to Drink. — Water is the only drink that will really quench thirst. We speak of drinking coffee, tea, or milk, but these are all made of water with something in it to give it a flavor. Nothing but water takes away our thirst. Pure water is the finest drink in the world. It tastes better than anything else, and it is more healthful. Cool water is better for us than very cold water. If you drink ice-water, take only a sip at a time and hold it in the mouth a few seconds before swallowing it.

The best drinking water comes from mountain springs and deep wells. Water from shallow wells may be good, unless the well is very near a house. Then it is often made impure by drainage matter from the house, and even if it looks clear, it is not safe to drink unless boiled. Water from carefully protected reservoirs is usually good. Water from rivers should be boiled for drinking purposes.

people drink too little water. Grown-up should drink nearly two quarts a day. Children who are running about and exercising constantly, require nearly as much. We need much more in summer than in winter. Can you think of any reason for this?

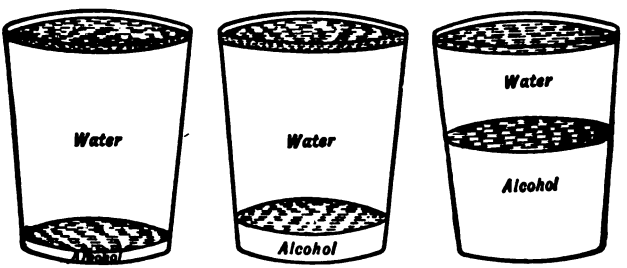
You need never be afraid of drinking too much good water unless you are very warm, and not then unless the water is very cold. You may drink it either at meal-times or between meals, whenever you are thirsty.

Grown-up people often drink water with a little coffee or tea in it, because they like the taste. Both coffee and tea make children excitable. Cool water, milk, or very weak cocoa are all the drinks young people need with their meals. Soda water is water with a kind of gas in it to give it a biting taste and a little syrup to give it a flavor. You can drink soda water without harm if you do not take too much of it.

What is Injurious to Drink. — Sometimes a substance called *alcohol* is added to water to make drinks. Pure alcohol is good for some purposes, such as rubbing on a sprained ankle or wrist, but

it is injurious as a drink. Very likely you have seen alcohol used in a lamp to heat milk, or in a chafing dish. If so, you know that alcohol burns well. Any liquid with alcohol in it is harmful to drink.

Sometimes when a can of preserves is opened, we find that it is not good. It has *fermented*,



BEER WINE WHISKY

Showing the proportion of alcohol and water in beer, wine, and whisky

because the can was not quite tightly closed, — that is, some little plants, called *yeast*, got into the can through the crack and turned part of the juice to alcohol. Some drinks that have alcohol in them, like wines, are made from fruit juice by leaving it open to the air, so that the yeast floating in the air gets into the juice. Sometimes yeast, very much like the yeast used in making

ad, is placed in the fruit juice by the person who makes the drink, as in making beer.

Drinks that contain some alcohol are beers, ales, wine, rum, whisky, and brandy. Beer has the smallest quantity of alcohol, ales a little more, and wines more still. Rum, whisky, and brandy contain a large amount of alcohol. Alcohol makes people more thirsty. The person who begins by taking only a little alcohol is likely soon to want more. It then becomes a poison to him. So boys and girls should not use even the mildest liquor.

QUESTIONS

1. What is the most healthful drink of all? Why?
2. Where does the best drinking water come from?
3. What should be done to river water before we drink it?
4. Why should a well not be placed very near a house?
5. About how much water should children drink every day?
6. What other drinks are good for you to drink besides water?
7. For what may pure alcohol be used?
8. For what should alcohol *not* be used?
9. What is meant by fermenting?
10. What drinks contain alcohol?
11. What is the effect of drinking a little alcohol?

CHAPTER VII

COOKING

How Cooking Began. — There is an old story, said to have come from the Chinese, that tells how the art of roasting was discovered. Charles Lamb, an English writer, says that one morning the swineherd, Ho-ti, went to the woods, leaving his cottage in the care of his son, Bo-bo. The boy, being fond of playing with fire, let some sparks fall by accident into a bundle of straw. The fire could not be checked, and the house was burned to the ground. What was worse, with the cottage perished nine little pigs.

While Bo-bo was thinking what he should say to his father, an odor came to his nostrils unlike anything he had ever smelled before. He stooped down to see if there were any sign of life in the pigs, and burned his fingers. To cool them, he put them to his mouth, and "for the first time in his life (in the world's life, indeed), he tasted — crackling!" "Crackling" is the name Charles Lamb gives to roasted pork.

At length the boy realized that it was the pig that smelled so savory and the pig that tasted so delicious. He fell to tearing up whole handfuls of the flesh, and was cramming it down his throat, when his father came and began to beat the young rogue across his shoulders. Bo-bo heeded the blows no more than if they had been flies. When he had fairly made an end of the pig he was eating, he cried: "Oh, father, the pig, the pig! Do taste how nice the burnt pig is!"

Father and son sat down, and never left off until they had eaten all that remained of the nine pigs. From that day Ho-ti's cottage was always burning down. Soon other houses in the neighborhood began to burn. Fuel and pigs became enormously costly all over the district. Finally, somebody discovered that the flesh of a pig or of any other animal might be roasted without burning down a whole house. And that, so the story goes, was how cooking began.

Reasons for Cooking. — Although this is only a made-up story, it will help you to guess the principal reason why we cook food. It is because we like the taste better. There is, however, another

reason. You could, for instance, eat raw, dried corn, and, if you chewed it very fine, it might not give you any trouble, though a handful of it would feel heavy in the stomach. Put the corn into a popper and shake it over a hot fire, and what happens? One by one the kernels begin to pop. Instead of being heavy and solid, they swell to twice or three times their former size, and are light, crisp, and easy to digest, — that is, they can be made into a liquid after they enter the body. Cooking swells starchy foods and thus makes them more digestible. We do eat some foods raw, such as fruits, certain vegetables, and milk, but most foods are improved by cooking.

Different Ways of Cooking. — If some one should ask you in how many ways your mother could cook food, you would probably answer, "In many different ways." You would be thinking of the different articles that she could make, such as bread, pies, and cakes. But whatever she makes, she can cook in only four ways. She can *boil*, *bake* (or *roast*), *broil*, and *fry* food. The four ways of cooking are, then, boiling, baking, broiling, and frying.

If we heat an article of food by putting it into hot water, we *boil* it. If we place the food in hot air, as in an oven, we call it *baking* or *roasting*. If we place the food directly over or under a hot fire, without putting it into a pan or dish of any kind, we *broil* it. This is the best way to cook beefsteak.

COOKING IN COLONIAL DAYS

Showing the process of boiling over the fire and of baking in an oven

Sometimes food is cooked in hot lard or fat. We call this *frying*. It is not a very good way of cooking, because the food soaks up fat. Fried doughnuts are always so well soaked with fat that they are heavy, and therefore not very healthful.

The Effects of Cooking. — All meats should be thoroughly cooked, not only to make them taste better, but to make them safe to eat. Sometimes raw meat has tiny living animals buried in the muscles. If we eat the meat raw, these

little animals may grow in the human body and cause severe illness. Milk also is safer to drink if it is first placed over the fire and heated boiling hot, because it sometimes contains little living plants, called *bacteria.* These, also, may grow in our bodies, if we swallow them alive, and cause illness. If milk is taken from the fire before it has really boiled, the taste is almost the same as that of cold milk.

INDIAN METHOD OF BROILING

If roast meat is well browned on the outside, a sort of coat or covering for the meat is formed by the heat, and the meat inside is thus kept soft and juicy. It is very much the same with bread. We bake it in an oven because the heat forms a crust and keeps the inside soft.

All grains are largely starch. Although we cannot see the change as plainly with all grain

foods as we can with popped corn, cooking softens and swells the starch in them all, making them easier to digest than they would be if eaten raw. This is true, also, of peas and beans. You would hardly like to eat dry beans raw, they are so hard; yet cooked, they are soft and nourishing.

Cooking hardens the white of eggs; for this reason they are more digestible when soft boiled.

Almost all cooked vegetables are more healthful for us than those we eat raw. Potatoes contain a great many little grains or particles of starch. In the *raw* potato these little starch grains are very hard, but cooking swells them and makes them soft. When this cooked starch reaches the stomach, it is then made into sugar. Rice also contains a great deal of starch and should be thoroughly cooked. Beans and peas should be cooked a long time to make them soft. They should also be carefully chewed.

STARCH GRAINS
As seen through a microscope

The vegetables that are eaten raw — cucumbers, radishes, and celery — are not so healthful

as the vegetables we cook, because they are hard and contain little nourishment.

Ripe fruits are good for us; but all unripe fruits, such as green apples, should be cooked, or else they are very injurious.

The Value of Good Cooking. — A dear old German lady in New York was asked how she kept her husband and children so happy and contented in their very plain little home. "It is because I know how to cook," she replied. "My children know that every time they sit down to a meal, they will have something they will like to eat. My husband enjoys his dinner; we are all happy at meal-times, and the food does us good. That makes us happy all day."

Food well cooked and nicely served gives people an appetite; then mealtimes are always happy times. If we are cheerful and glad when we eat, the food digests properly. If we are cross about what we have, we usually suffer afterwards.

Every girl, and every boy, too, should learn how to cook. If you have never tried to cook anything, ask your mother to begin to teach you by letting you prepare something simple, like

oatmeal. When you can do that well, not forgetting to salt the water, try baking potatoes. The person who can make good bread or cake is a skilful cook.

QUESTIONS

1. Why do we cook food?
2. In how many ways can food be cooked?
3. How is food cooked by boiling?
4. How is food cooked by baking or roasting?
5. What is broiling?
6. Why is frying a poor way of cooking food?
7. Why should meat be thoroughly cooked?
8. What does cooking do to starchy food?
9. Does food digest well when you are cross and unhappy at mealtime?
10. What can you cook?

WRITTEN LESSON

1. Write a list of all the kinds of food you can think of that are improved by cooking.
2. Write them in lists, — the meat in one list, the grains or cereals in another, the fruits and vegetables in a third.
3. Write a list of five kinds of food that are improved by baking or roasting. Five kinds of food that are cooked by boiling. Three kinds of food that are sometimes eaten cooked and sometimes uncooked.

CHAPTER VIII

FOOD HABITS

How Much to Eat. — The only way by which we can tell how much we ought to eat at any one time is to obey our appetite. As a general rule, it is wise to stop eating when you think you can eat no more substantial food. If you wish to finish a meal with a cooky, leave room for it. Stop eating other things before your hunger is quite satisfied.

Children often sit down to the table and, after they have seen what has been provided, decide that they do not care for anything. They do not refuse to eat because they are ill — not at all. They are hungry, but they just sit, very likely with sulky instead of happy faces, and refuse to eat wholesome food simply because they do not like the taste! Can you think of anything much sillier? If we try, we can learn to eat almost any kind of wholesome food, and certainly we shall be better and stronger men and women for so doing.

A young child should not eat so much food as a man. A person who is active or busy all day, either in an office or out of doors, needs a great deal of nourishing food. An invalid, or a person who has even a slight illness, may eat less than one who is perfectly well. The amount and kind of food we eat should be adapted to the climate in which we live, to the season of the year, to our age, our health, and our occupation.

When to Eat. — People in America usually have three meals a day — breakfast in the morning, lunch or dinner at noon, and supper or dinner at night. It is best to eat at meal-times only. Children, however, because their stomachs are not as large as those of grown-up people, eat less at a time and must eat oftener. If you get hungry between morning and noon, or between noon and night, eat a lunch if you wish, but eat only one and take it at *the same time every day.*

You can easily see why it is not wise to be constantly eating candy, munching apples, or even chewing gum. The stomach needs time for rest as much as do the other parts of our bodies, and the rest periods must be at regular times.

A FEW GOOD RULES ABOUT EATING

1. *Eat slowly, chewing your food well.*
2. *Eat at regular times every day.*
3. *Eat enough to satisfy your hunger.*
4. *Drink plenty of water, but not a great deal of ice water.*

Remember that as water is the only drink that satisfies thirst, it is better to take this clear than with any substance in it. Water that contains alcohol is especially injurious to the stomach. When the stomach has been injured, it cannot do its work — that is, it cannot take care of the food you eat, and you may become ill.

Have you ever thought why the law does not allow alcoholic drinks or tobacco to be sold to boys and girls? If you do not know, ask your father to tell you.

QUESTIONS

1. When should we stop eating?
2. What has climate to do with the kind of food we eat?
3. Name some of the kinds of food you do not like to eat.
4. Are they good, nourishing foods?
5. Could you learn to like them?
6. Give four good rules about eating and drinking.

CHAPTER IX

HOW THE FOOD GETS INTO THE BODY

PUT a lump of sugar into a tumbler of water and leave it for ten minutes. Can you see any sugar now? Is the sugar still there? Drink a bit of the water and decide from the taste whether the sugar is there or not. We say that the sugar has been dissolved in the water. That is, it has been so mixed with the water that one cannot see it, and it appears as a liquid instead of a solid.

Food is carried around the body by the blood. The blood takes the food to the brain, the muscles, and the bones. But the blood cannot take pieces of solid meat or bread through the tiny blood vessels. The food must, therefore, be dissolved, or made a liquid, before it can get into the blood. The changing of foods into such a form that they may be dissolved and carried to the various parts of the body by the blood, is called *digestion.*

The Mouth. — Look at your mouth in a mirror. You will see that it is hollow, like a small cave. In it are *teeth* and a *tongue.* Behind the tongue

you can see an opening. Let us see what the mouth does to help digest food.

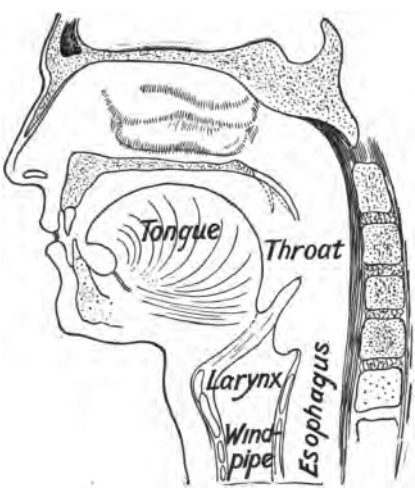
In the first place, bite off a piece of bread with the teeth and chew it into fine bits. The stomach can then dissolve or digest the bread better, for the same reason that powdered sugar dissolves more quickly than a solid lump of sugar.

The tongue also helps in chewing. Look at your tongue in a mirror once more. Do you see the little bunches on it? In these little bunches are bodies too small to be seen without a microscope: these are called *taste buds.* They tell us whether the food that we take into our mouths tastes pleasant or not.

Saliva or What the Mouth Secretes. — There is something else in the mouth that helps us to digest food. As we chew the mouthful of bread, it is mixed with the moisture of the mouth. This moisture is called *saliva.* It comes from little pockets or glands, called *salivary glands.* We cannot swallow food dry. A liquid, such as soup, we can swallow as soon as it is taken into the mouth, but if we try to swallow a piece of cracker unmoistened by the saliva, we are likely

to be choked by it. The saliva moistens the food so that we may swallow it and turns part of the starch in our food to sugar. This also dissolves, so that when the starchy food reaches the stomach it is already partly digested.

The Esophagus. — After the food is chewed and moistened by the saliva, the tongue pushes it back into the throat. In the front part of the throat is a tube called the *windpipe*, through which the air that you breathe passes into the body. Behind the windpipe is a second tube called the *esophagus* (ē-sof'-a-gus). This tube connects the mouth and the stomach. When we swallow, the food passes down the esophagus into the stomach. If you try to talk or laugh when you are about to swallow, some of the food will probably get into the windpipe, and you will



A Section through the Head
Showing the relation of mouth, throat, etc.

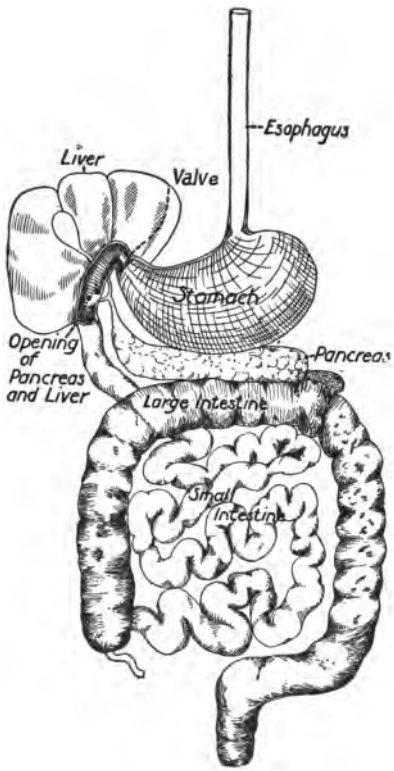
choke. This is what happens when you "swallow the wrong way."

Over the windpipe is a little lid, or cover, which closes the opening to the windpipe and allows the food to pass over into the esophagus. This little lid is closed or shut down over the windpipe only when we swallow.

The Stomach. — The stomach is a kind of bag at the end of the esophagus. It is on the left side of the body. The stomach of a grown-up person is large enough to hold about three pints of food at a time. If you can get from the butcher a piece of tripe, you will see what the stomach bag is like, for tripe is a piece of the wall of a cow's stomach. The soft part with many folds, or the inside of the tripe, is the stomach part. Our own stomachs are somewhat similarly formed.

The food that has been chewed and swallowed enters the stomach directly from the esophagus. In fact, it takes only a few seconds. Immediately the stomach begins its part in the digestive work. The muscles of the stomach move slowly, pushing the food about, much as cream is moved about in a churn to make butter.

Gastric Juice or What the Stomach Secretes. — The stomach has thousands of glands in its walls, corresponding to the salivary glands of the mouth. Each gland is shaped somewhat like a little bottle with its mouth opening into the stomach, and each pours a liquid out of its mouth into the stomach. The liquid is a sour substance known as *gastric juice.* The food in the stomach starts these thousands of gastric glands into action, and gastric juice is thus poured upon and mixed with the food as it moves about. The gastric juice digests or dissolves a large part of the food. It turns the food into a soft, pulpy mass, called *chyme.*



THE DIGESTIVE ORGANS

The Small Intestine. — The food passes from the stomach into the upper end of the small intestine. This is a tube about twenty-five feet long and from one to two inches across. It is coiled up inside the body. In the intestine, as well as in the mouth and the stomach, there are also juices which soften and digest the food still more. By their actions in the intestine, the food is changed into a liquid of a whitish color, called *chyle.*

The Villi. — When the food is all digested and is in the form of a liquid, it has to be sent to the parts of the body where it is needed, so that it can enable the heart to beat, and the arms and legs to move. The walls of the intestine are covered with little projections, like tiny fingers, standing on the surface. They are *villi.* Each *villus* is very small like the tiny threads of a piece of velvet. There are about four millions of these little villi on the walls of the intestine.

The villi are full of the tiniest blood vessels you can imagine. As the digested food passes slowly along the intestine, each of these blood vessels takes up a little of it and mixes it with

the blood that is flowing through. The blood then flows around to the different parts of the body, carrying this digested food with it.

The Liver and What it Secretes. — You have probably seen an ox's or a calf's liver at the meat market. If you have not, ask the butcher to show you one. The liver in our body is much like that of an ox, except that it is smaller. The liver is dark red and is the largest organ in the body. In a grown person the liver weighs about four pounds. Its place is on the right side, a little above the stomach. It secretes a fluid or juice called *bile*. When food is being digested, the bile passes through a tube into the intestine to mix with the food as it enters from the stomach.

The Pancreas and What it Secretes. — The pancreas is a long, thin gland situated just below the stomach. It secretes the *pancreatic fluid*, which is necessary to digest the food.

As the blood in the villi absorbs the food, it leaves behind any food that may not have been digested properly, and all waste matter.

The Large Intestine. — The waste matter and any substances that are not digested pass from the

small into the large intestine. The large intestine is a tube similar to the small intestine, only it is larger around and not so long. It is about five feet in length, and through it the waste matter passes out of the body. The small and the large intestine together are called the *bowels.*

The Process of Digestion. — This, then, is the whole of digestion. The little piece of bread that you bit from the slice is chewed and partly dissolved by being mixed with saliva. The food is then swallowed and passes over the windpipe through the esophagus into the stomach. There, by the gastric juices, it is changed into a soft pulpy mass. Every little while the small end of the stomach opens and allows a bit of the food to pass through into the small intestine. In the intestine the food is mixed with bile from the liver and is changed into a white liquid by the pancreatic fluid. The villi then take the useful part of the food and give it to the blood, which carries it through the body. The waste matter moves on into the large intestines and then out of the body.

Our bodies are carrying on this wonderful work

of digestion every day, but we do not realize it unless we are ill. As long as we are well we shall have little occasion to think whether our food is digesting or not. Tongue, teeth, saliva, stomach, and intestine will do their work if they are treated with proper care.

QUESTIONS

1. By what is food carried around the body?
2. What is digestion?
3. What have you in your mouth to grind food?
4. With what is the tongue covered?
5. What is saliva? How does it help to digest food?
6. How does food get from the mouth to the stomach?
7. What is the shape of the stomach? Where is the stomach?
8. What does the stomach secrete? What does this do to the food?
9. What is the small intestine?
10. What happens to the food in the small intestine?
11. What are the villi? Describe them.
12. What part do they play in digestion?
13. What is the largest organ in the body? What does it secrete?
14. By what is pancreatic fluid secreted?
15. What part of the food does the blood take up?
16. What becomes of the waste matter?
17. Tell in your own words the process of digestion.

CHAPTER X

GOOD DIGESTION AND HOW TO KEEP IT

THE following table will give us some idea of the foods that are easy to digest, those that are less easy, and those that are hard to digest: —

TABLE OF DIGESTIBILITY

FOODS VERY EASY TO DIGEST	FOODS LESS EASY TO DIGEST	FOODS HARD TO DIGEST
Rice	Hard-boiled eggs	All fried foods
Tapioca	Boiled potatoes	Beans and peas
Milk	Boiled mutton	Boiled cabbage
Bread (cold)	Roasted mutton	Roasted pork
Soft-boiled eggs	Roasted beef	Roasted duck
Baked potatoes	Broiled pork	Boiled salmon
Codfish		Cheese
Boiled trout		
Raw oysters		
Broiled steak		
Boiled beef		
Boiled chicken		
Roasted turkey		
Roasted goose		

People who live an active life out of doors seldom have any trouble with their digestive powers. People who constantly have trouble with their stomachs, because their stomachs are weak or because they have not taken care of them properly, are called *dyspeptics.* Dyspepsia is often caused by eating *too much food,* by eating *the wrong kind of food,* or by eating *too fast.*

As you have already learned, even foods that are really *hard* to digest, like beans and peas, contain a great deal of nourishment and are good for us if eaten properly. The above table will help you to understand what foods you must eat carefully — that is, the foods which you must eat in small quantities at a time and must chew thoroughly.

QUESTIONS

1. Must we eat only foods that are *easy* to digest? Give the reason for your answer.
2. What is dyspepsia? By what is it often caused?

WRITTEN LESSON

1. From the Table of Digestibility and from what you have already learned about different kinds of foods, write a list of what would be a good dinner for a boy or a girl. You may have a soup, one kind of meat, two vegetables, and a simple dessert.

CHAPTER XI

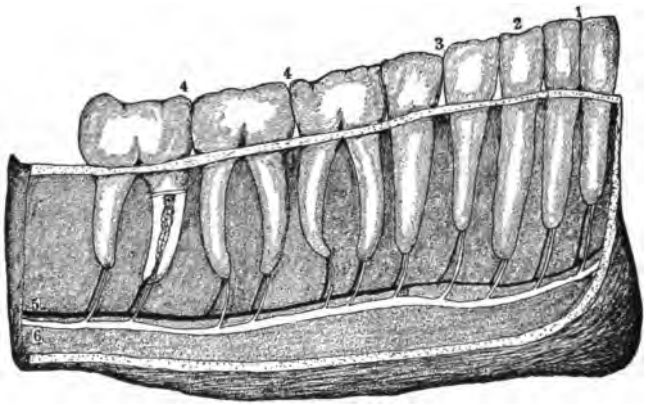
THE TEETH — THEIR FORMATION AND CARE

The Formation of the Teeth. — A tooth is a piece of bone covered on the outside with *enamel.* This enamel is a substance which is harder than any other part of the body. It is somewhat like the glazed porcelain on the outside of crockery. If very hot water is poured into a crockery dish, the glazing is liable to crack. If we take anything very hot into the mouth, or bite any very hard object, we are liable to crack the enamel of our teeth, and then they will begin to decay.

Inside the enamel there is the bone of the tooth, and inside the bone there are very small openings through which tiny blood vessels and nerves enter the teeth. The inside of a tooth is much softer than the enamel which covers it. After the enamel is cracked or decayed, the softer inside part decays very quickly.

If you should bruise a finger so that the nail should come off, another nail would grow; but it is not so with the teeth. We have just two sets

and no more in all our lives. The first teeth begin to form at the age of six to eight months. They



A Side View of the Lower Jaw with the Outer Walls of Bone removed, showing the Teeth in Proper Place

1, the two incisors; 2, the canine; 3, the two bicuspids; 4, the three lower molars (the last molar is sometimes called the wisdom tooth); 5, a blood vessel; 6, a nerve

keep on coming, one after another, for nearly two years, until there are twenty in all.

By the time the child is seven years old, the baby teeth begin to be shed, and in the place of each there comes a grown-up or permanent tooth, and other new ones grow up behind these. There are thirty-two permanent teeth. They keep coming until we are about twelve or thirteen years old. The last four, however, called *wisdom teeth*

do not usually come until a person is twenty years of age.

The front teeth are thin and sharp; they are fitted for biting food. The back teeth are larger and broader; they do the principal part of the chewing, or grinding of the food. The four front teeth of both the upper and the lower jaw are called *incisors*, or "scissors" teeth. The tooth next the incisors is a *canine*, or dog tooth. Then comes a *bi-cuspid*, or two-pointed tooth. The others are the *molar*, or grinding teeth. If you think of the word *miller* in connection with the word *molar* you will understand why the back teeth are so called. The miller does to the corn what the molar teeth do to our food—he grinds it.

The Care of the Teeth.—To keep our teeth in good condition, we must take proper care of them. If they are allowed to decay, we shall lose them and be compelled to go through life without teeth or to wear false ones. The teeth should be cleaned with a soft toothbrush every morning and particularly at night before bed-time. After each meal we should push from between

the teeth any bits of food that may have lodged there. We should use for this purpose nothing harder than an orange-wood or a quill toothpick. A piece of silk thread is better than any kind of a toothpick. If we find the least bit of a decayed spot in a tooth, or if we have toothache, we should have a dentist examine our teeth at once.

Hard food is better for the teeth than soft food. A very important part of caring for the teeth is to use them for chewing proper food. The better we treat our teeth, the longer we shall keep them. With good care, teeth will usually last a lifetime.

QUESTIONS

1. What is a tooth?
2. With what is it covered?
3. How many sets of teeth do we have?
4. How long does the first set generally last?
5. How many permanent teeth are there?
6. What are *incisors?*
7. What tooth is next to the incisors?
8. What does *bi-cuspid* mean?
9. Why are the back teeth called *molars?*
10. If we do not use our teeth, and if we do not care for them well, what will happen to them?

CHAPTER XII

HOW THE FOOD IS CARRIED AROUND THE BODY

We have learned how the solid food that we eat is made a liquid and then is taken from the intestine into the blood. How does the blood carry the digested food to the various parts of the body?

We know that a liquid cannot flow uphill. The blood might go down the legs into the feet because of its weight, but it would never run up to the brain of its own accord. The blood has to be pumped through the body just as water is pumped from the bottom of a well.

The Heart. — The heart is the pump of the human body, and is about the size of your closed fist. It is much like a strawberry in shape. The larger end of the heart is in the center of the chest. The small end points downward and a little toward the left.

If you place your hand upon the front of your chest, at about the level of the armpit and a little toward the left side, you can feel your heart beat. As the heart beats, you will notice that it goes

a clock, "Tick, tock — tick, tock," with a little pause after the "tock." With each "Tick, tock," the heart contracts much as we empty a lemon by squeezing. This contraction we call the *beat* of the heart. At the pause after each "Tick, tock," the heart rests for a little, less than half a second, and this is the only kind of a rest the heart ever gets. We rest our brains and bodies by sleep, but even while we are asleep the heart keeps on beating.

A Tobacco Heart. — Have you heard the expression a *tobacco heart?* The heart of a man who smokes much usually beats too fast, a condition which means that the heart is not healthy.

The boy who smokes cigarettes is very likely to develop a tobacco heart, or some other trouble. The boy who hopes to succeed in any business or any profession when he is a man, in these days of competition, must let cigarettes absolutely alone. In many prominent business houses and offices the first question asked of a boy who applies for a position is, "Do you smoke cigarettes?" If he does, he is not wanted. Business men know that the boy who uses cigarettes is, or soon will be, so

affected in mind and body that he cannot do good, strong work. No boy who wishes a sound heart in a sound body should learn to smoke.

The Pulse. — The throbbing caused by the movement of the blood is called the *pulse.* You can feel your pulse by placing the fingers of one hand upon the wrist of the other hand. You can also feel it directly in front of the ears or in the hollow at the side of the forehead (the temple). The heart of a grown person beats at the rate of about seventy-two times a minute. A child's heart beats considerably faster. We test the rate of the heart beat by feeling the pulse.

If you sit quietly for some time and count your pulse for exactly a minute, testing the time by a watch, you will find how many times your heart beats naturally in a minute. If you run about the room two or three times, and then count the pulse once more, you will find that the exercise has quickened the pulse, and that your heart beats many more times in a minute.

The Blood. — You do not need to be told the color of the blood. It is the red in the blood that makes our cheeks and lips red, if we are well.

Blood is made up largely of water, and, like water, the liquid part itself is colorless. You know that clear water has no color, and yet water in a mud puddle looks as if it were brown. This is because there are thousands of bits of brown soil in it, so near together that the water itself appears of a brown color. Blood looks red because it has in it millions of tiny, reddish particles. These are shaped like pennies, round and flat. They are called *red corpuscles.* The word *corpuscle* means "little body," that is, "little piece." The red corpuscles are so small that it would take more than three thousand of them placed side by side to make a row an inch long.

Besides these little red corpuscles there are other tiny particles floating in the liquid of the blood. These are known as *white corpuscles.*

The red corpuscles are the messenger boys of the body. They pass around with the blood, taking air from the lungs to all parts of the body. The white corpuscles are the street cleaners. They go about taking away any poisonous germs or substances that might cause trouble. The red corpuscles always stay in the blood vessels, not mov-

ing of themselves, but going only where the blood carries them. The white corpuscles go wherever there is cleaning to be done, even if they must pass out into the flesh itself to do their helpful work, for they can move of themselves. If a splinter gets into your finger, so deep that you cannot pick it out, the white corpuscles push it out for you. Your finger turns white about the splinter. You say that it "festers," but what you mean is that the white corpuscles from the blood have gathered around the splinter and are making a little sore to push the splinter out.

The liquid part of the blood has in it the food which was absorbed from the intestine. It carries this liquid food to all parts of the body.

Arteries and Veins. — The *blood-vessels*, or the tubes which hold the blood, are of two kinds. Those that take the blood away from the heart are *arteries;* those that bring it back to the heart are *veins.* Both arteries and veins divide and redivide into thousands of little branches. These branches grow smaller and smaller the farther away they are from the heart, until finally the smallest arteries are so tiny that they are called *capillaries,*

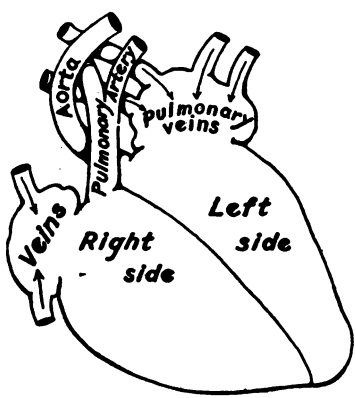
or hair blood-vessels. So small are they indeed that you cannot see them without a microscope. At your wrist are blue lines running from the hand up the arm. They are veins. Let your hand hang down a minute, and these lines show more plainly.

You have perhaps noticed that when you pump water from a well the liquid does not flow steadily, but comes from the spout in spurts, one spurt each time you pump. If the water is allowed to run from the spout into a long trough, after it is a few feet away from the spout it ceases to come in spurts and flows steadily along the trough. The blood also is pumped by the heart into the arteries by spurts. As it moves farther from the heart, the spurts are less pronounced. By the time the blood gets into the veins for the return journey to the heart, it flows as steadily as the water in the trough.

Circulation. — Let us go with a red corpuscle on its trip around the human body and see if it is not an interesting journey.

We will start at the heart. "Tick, tock," it goes, and our little blood corpuscle is pushed out of the right side of the heart into the lungs.

From the air in the lungs it picks up a gas known as *oxygen*. The oxygen, as we shall see, helps to make the blood pure. After taking its load of oxygen, the corpuscle goes back to the heart once more. This time it goes into the left side. Presently it comes out again from the left side, and starts on its real journey over the body.



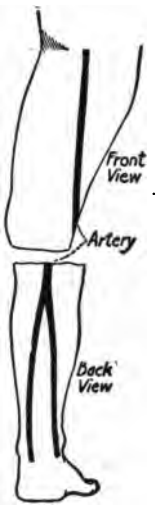
THE HEART

Together with millions of little particles like itself, it passes into the main artery of the body. The arteries, you remember, are the tubes that take the blood *away* from the heart. The main artery divides into several branches which carry blood to the head, the arms, the legs, and all the other parts of the body. Let us say that our corpuscle goes by way of the arm to the fingers. Leaving the main artery of the body and entering the large artery of the arm, it floats down the arm. This artery in the arm again divides into still smaller branches. We can feel the throbbing of the artery

at the wrist, as the blood containing the little red corpuscle passes into the hand.

Again and again the arteries divide and grow smaller, just as the large branches of a tree divide into smaller and still smaller branches, with tiny twigs as the smallest branches of all. Finally, in the finger tip itself the corpuscle reaches the end of its forward journey.

SHOWING THE MAIN ARTERY OF THE ARM



SHOWING THE MAIN ARTERY OF THE LEG

It now makes its way through a very tiny tube, or capillary, where the liquid part of the blood gives up some of the food that it obtained from the intestine before it entered the heart, and which it has been carrying through the heart and the lungs. The corpuscle also gives up the oxygen which it absorbed from the air while passing through the lungs, and takes some of the waste substances from the tissues of the body.

While the corpuscle contained the oxyg
pure. Now that it has left the oxygen b
the capillaries and has taken up some
waste substances of the body, it enters th . vein
as *impure* blood.

From the small veins it goes on into the larger ones, until finally it enters one of the large veins that take the blood back to the heart. Our corpuscle comes back into the left side of the heart again.

There is one main artery that carries the pure blood from the heart about the body. There are two large main veins that bring the impure blood back to the heart. The blood moves around through the body in the blood vessels. The movement is called the *circulation of the blood.*

Have you noticed how red the face of a person becomes who takes large quantities of alcoholic drinks? This is because the alcohol causes the blood vessels of the skin to become larger than their natural size and they do not contract properly. The blood is thus allowed to pass through without being properly controlled by the natural expansion and contraction of the blood vessels.

QUESTIONS

1. Where is the heart? What is its size and shape?
2. How does the heart get the rest it needs?
3. What does the heart do by its beating?
4. What do you mean by the pulse?
5. How is blood like water?
6. What makes blood look red?
7. Of what use are the red corpuscles?
8. Of what use are the white corpuscles?
9. What are the blood vessels called that take the blood from the heart?
10. What are the blood vessels called that take the blood back to the heart?
11. What are the capillaries?
12. What do the red corpuscles get in the lungs?
13. When is blood pure? When is blood impure?
14. What do we mean by the circulation of the blood?
15. What effect has alcohol upon the blood vessels?

ACTION LESSON

Place your hand upon your chest and find where your heart is from the feeling of the heart-beats.

Feel the pulse at your left wrist; in front of your left ear.

Hold your hands above your head for a few seconds. How do they change color? Let them hang down. What difference do you see? Why is there any difference?

Shake your hands quickly. How do they change color? What is the reason?

Find a vein near enough to the skin so that it looks blue. Is it a straight line?

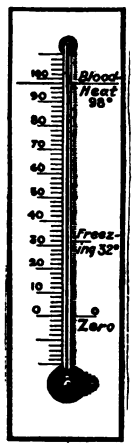
CHAPTER XIII

THE USE OF THE CIRCULATION

THE blood is all the time flowing about the body in the arteries and veins. When the liver or the lungs or any other organ needs food or air, it takes this from the blood as it flows by. The blood will renew its food supply at the intestines after a meal, and its oxygen at the lungs. At the same time the blood is leaving food or air, it is taking up and carrying along with it any waste matter of which the organs must get rid.

The Temperature of the Human Body. — A fish, a turtle, or a frog is nearly always the same temperature as the water or the air in which it lives. In the summer the turtle, as it basks in the warm sun, feels warm to the touch, but in the winter it feels cold. In the winter the body of the turtle or fish is almost frozen in the icy water. The fish, turtle, and frog are "cold-blooded" animals. Human beings are "warm-blooded" animals. The temperature of a person in good health is always the same. By placing a

thermometer with a bulb under your tongue, you can tell how warm your body is. You will find it to be a little over 98° Fahrenheit, as warm as the hottest days of summer. Very likely at some time when you have been ill, the doctor has tested your temperature with a thermometer. Sometimes when people are ill, we say they have fever. We mean that their temperature is higher than it is in health. Sometimes the temperature is below normal, that is, lower than 98°. This, too, means that the person is not well.



THERMOMETER
Showing blood heat

It is true that we feel warmer after playing tennis or raking hay on a hot July afternoon than we do after sliding down hill in January. It is, however, only the skin that feels warm or cold. We are just as warm inside our skin in the winter as in the summer. The blood vessels expand and contract. When the vessels in the skin expand, we feel warm because a larger amount of warm blood is passing through the skin where we feel the heat. When the ves-

sels contract, we feel cold because there is less of the warm blood passing through the skin, and the cool air cools the skin.

How the Blood is Warmed. — The blood in our bodies is always warm. It is warm because it flows through parts of the body that are burning the food we have eaten and thus producing heat.

The water in the boiler connected with the kitchen range is heated by burning coal in the stove, and may be carried in pipes to warm other parts of the house. So the blood is warmed by the burning, or *oxidizing*, we call it, of the food in our bodies. The warmed blood flows through the other parts that are not producing heat and warms them.

The blood in the interior of the body is warmer than at the surface. We do not notice its greater warmth so long as it is below the skin, but feel it only when the warmer blood is brought to the skin. For instance, we feel particularly warm after we have been running hard or taking much exercise, because the exercise brings the warm blood to the skin. We are really cooling off, however, since this warm blood is being cooled by the

air. If the body is likely to become too warm, it sends the warm blood to the skin to be cooled off.

If the blood circulates well, the body is warm all over. If the circulation is sluggish in the hands, feet, or ears, those parts grow cold. If your hands or feet are cold, the blood is not flowing through them fast enough.

The next time your fingers feel cold, instead of trying to warm them at a stove or over a register, rub them hard. You will find that they become warm quickly and stay warm for a long time. The rubbing starts the blood to circulating through them freely once more. Brisk walking or running is far better for warming the body than wrapping in heavy clothing or sitting over a hot stove or register.

QUESTIONS

1. Where does the blood get air to carry to the various parts of the body?
2. What is the main difference between the blood of a frog and that of a man?
3. Why do we feel warmer in summer than in winter?
4. When we feel warm, after playing hard, what is really happening to our blood?
5. What makes our fingers cold in winter when our bodies feel warm?

CHAPTER XIV

CUTS AND WOUNDS. — HOW TO TREAT THEM

Bleeding. — If there is a leak in a water pipe, the water flows out. If the leak is large, the water flows quickly. From a small opening it comes more slowly. If you cut your finger, you are almost certain to cut into a blood vessel, and then the finger bleeds. If it does not bleed, it means that you have so slight a scratch that hardly more than the skin has been pierced.

If an artery is cut, the blood flows out rapidly, in *spurts*. Do you remember why the blood in the arteries flows in spurts? We know when an artery has been severed from the way the blood flows out and because the blood is bright red.

If a vein is cut, the blood flows gently and evenly, never in spurts. The blood in the veins is dark red. Is this pure or impure blood?

A wound in an artery is much more dangerous than one in a vein, and it must be looked after at once. If the artery is large and the wound is not attended to, the person may bleed to death.

If we have a slight wound, such as a cut in the finger, the bleeding stops of itself after a short time. You may, perhaps, have noticed, when you have had a cut or a scratch, how the blood thickens in the opening itself, or outside of the cut on the finger. We call the thickened blood a *clot.* Blood clots after it flows out of the blood vessels. This holds the sides of the wound together firmly, so that the blood from within cannot flow through the opening.

How to stop Bleeding. — All we need to do for a small cut is to press the edges together and bind them in this position tightly with a *clean* cloth. This will keep the cut from bursting open again, and will allow it to heal. A *soiled* cloth should *never* be used to bandage a wound, even though the cut be only a slight one. Such a cloth is liable to hold bacteria (poisonous germs), which might cause inflammation in the wound. Every wound should be washed in clean, and preferably boiled, water, before it is bound up. The washing will take away any germs that might otherwise make trouble.

If the cut is deep, the bleeding may not stop

of itself. When a wound of any kind is followed by a *spurting* of bright red blood, an artery has been cut. The only way to stop the bleeding is to press the artery together *above the cut*, that is, between the cut and the heart.

Figure 1 shows how we may grasp an arm so as to stop bleeding anywhere below the elbow. The best way to stop the bleeding is to put a bandage tightly around the arm. To learn just how to arrange such a bandage, have a boy or girl bare the arm to the shoulder. We will suppose the arm to have been cut below the elbow. Wind tightly around the upper part of the arm a good-sized handkerchief. Tie it as shown in Figure 2.

FIG. 1. — SHOWING HOW TO COMPRESS THE ARM TO STOP BLEEDING

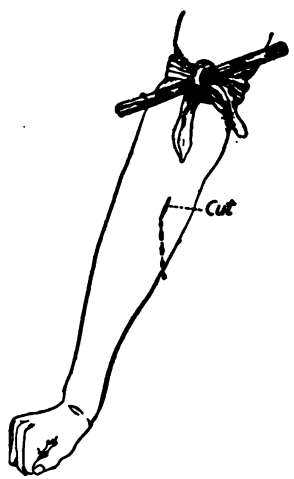


FIG. 2. — SHOWING THE METHOD OF APPLYING A LIGATURE

Now run a stick through the knot. Give the stick a turn or two, twisting the bandage and binding the arm tightly. With a wound in the leg, the plan for stopping the flow of blood is similar.

In case of a *real* cut, the stick should be twisted until the bleeding stops. The life of the person may be saved by this means, and for this reason every boy or girl should understand just how to arrange the bandage. After the bleeding has been stopped, a physician should be summoned at once. The bandage must be kept in position until the physician comes and the cut artery has been tied.

QUESTIONS

1. How do you know when a wound has opened a vein and when it has opened an artery?
2. What do we mean by a blood clot?
3. How should slight cuts be cared for?
4. How may the bleeding be stopped when an artery has been severed?
5. How long should the bandage be kept in place?

CHAPTER XV

HOW AND WHY WE BREATHE

Why we Breathe. — Ask some one to hold a watch, and count every breath you take for a minute. You could not get along for a single minute without breathing. Let us see why.

Place a lighted candle in a glass jar and put the cover on the jar. Notice how quickly the light goes out. The flame needs to take oxygen from the air, and when the oxygen is used up, it can no longer burn.

A fire will not burn in a stove unless it has air. If we want to make the fire burn well, we open the draft. The larger the draft, the faster the fire burns and the hotter the fire is. Besides a draft, the stove must have a chimney to carry off the smoke and gases made by the burning fire.

We can no more live without air than the fire can burn without it. To keep the food in our bodies burning or oxidizing, we must have air. The waste gases must also be carried off, as they are from the stove.

Respiration. — Giving the body its proper supply of air and carrying off the waste gases we call *respiration.* Every time we breathe in (which we call *inhaling*) we take air into our bodies. From the air the blood takes the oxygen it needs to keep the body warm and in good condition. Every time we breathe out (*exhale*), we send from the body waste gases and moisture.

Get some limewater from an apothecary and pour a little into a tumbler. Place one end of a glass tube in the mouth and the other end over the surface of the limewater. If you breathe in, so that air is drawn away from the tumbler, the limewater is unchanged. If you breathe out, so that breath passes into the tumbler, or better still, if you blow into the liquid through the tube, the limewater turns white. The gas which you send into the glass from your mouth turns the liquid white. Put your mouth a few inches from a cold mirror and breathe against the glass. The moisture which you breathe out gathers on the mirror in small drops.

The Chest. — When we breathe, we take air into our chests and then force it out again. The chest

is a box. The sides are called the *ribs*. The chest box is closed on all sides, except at the top, where the *windpipe* leads to the throat.

How we Breathe. — We can only partly control our breathing. We can hold the chest still for a minute, and we can take a long or a short breath. If we try to keep up such exercises long, however, we grow tired. As soon as we turn our attention to other things, the breathing takes care of itself.

We breathe by making the chest cavity larger, and thereby sucking the air into it. When we make the chest smaller again, the air is pushed out. With the aid of a rubber ball you can see just how the breathing is done. Place a hollow rubber ball with a hole in it under water and squeeze it. Notice how the air is squeezed out. Still holding it under water, let it expand. The ball fills with water. Every time it is squeezed, air or water rushes out. Every time it expands, air or water rushes in. In the same way, as the chest is made smaller or larger, the air rushes in or out. The chest, as you have learned, is a box; but it is a box with a curved top, curved sides, and a hollow curved bottom. The sides and

top are formed by bones. The bottom is a layer of soft muscle, called the *diaphragm* (dī'a-frăm). Below the diaphragm, on the right side, is the *liver*, and on the left side is the *stomach*.

When we breathe, we enlarge the chest in two ways. We lift up the bones forming the sides of the box, called the ribs. We also draw down the diaphragm. Place your hands on your sides, a little below the arms. Now take a long breath. You feel the ribs rise as you breathe in. Place your hand below the diaphragm. Take another long breath, and you will notice that the stomach seems to push out as you inhale. It is not air entering the stomach that makes it swell out, for air does not go to the stomach at all. The stomach swells out because the diaphragm is flattened downward and pushes against the stomach and bowels, and so pushes them outward a little. When the diaphragm is at rest, it curves upward until it is like a hemisphere in shape. When the lungs are full of air, the diaphragm is flat.

Nose Breathing and Mouth Breathing. — The nose was made to smell with and as a passage for the breath. The mouth was made as a pas-

sage for food. If your mouth is closed when the chest is enlarged, the air will enter the chest through the nose, as it should. If your mouth is open, the air will rush in that way because the passage is larger. When we breathe through the nose, we cannot help breathing slowly because the nostrils are too small to allow much air to pass at a time. By the time the air reaches the lungs it is warmed. When we breathe through the mouth, we draw a large amount of air down the windpipe so quickly that it is still cold when it reaches the chest.

If you cannot breathe easily through the nose, or if you breathe through the mouth when asleep, a physician should examine your throat. Never get into the habit of breathing through the mouth.

Have you noticed the little hairs on the inside of the nose? These are dust filters. As the air passes up into the nose, particles of dust are caught by the hairs and kept out of the throat and lungs. If the particles are large enough to cause a tickling, we blow them out. Sometimes they cause sufficient irritation to make us sneeze.

Chest Development. — Breathe out, or exhale, sending out all the air from your chest that you can. Find with a tape measure how many inches you are about the chest with the air breathed out. Fill the chest with air and measure again. How much larger is your chest when it is full of air?

Place your hands about your waist, pressing them as tightly as you can. Is the length of each breath shortened or lengthened by the pressure? We *must* expand our chests to take in air; so if the waist is compressed, the stomach and other organs are squeezed. The chest needs plenty of room, so that the ribs may rise high. After you have taken in a full breath, you should be able to slip two fingers between your belt and your body without the belt's feeling tight.

It is a good thing to have a large chest. It helps one to run fast and long, to have a good voice, and to be strong and vigorous generally. Boys may well be proud of chests that are full and expand several inches, for this means that they have strong muscles. The girl with a large, full chest is straight and has a fine carriage. A person whose chest is small and hollow is apt to

stoop and may have weak lungs. *If you take a dozen long breaths several times a day, you can develop your chest.* The gymnastics given in many schools are a splendid aid to chest development.

QUESTIONS

1. Why does a candle placed in a closed jar soon stop burning?
2. What can we do to make the fire in a stove burn faster?
3. How do our bodies get air?
4. What is respiration?
5. What do we breathe in? What do we breathe out?
6. What does the gas that we breathe out do to limewater?
7. What do we breathe out besides the used gas?
8. What do animals breathe in? What do they breathe out?
9. What is the windpipe?
10. How do we breathe?
11. How is the chest formed?
12. What is the diaphragm?
13. Why should we breathe through the nose instead of the mouth?
14. What uses for the mouth can you think of? What uses for the nose can you think of?
15. What happens to our chests when we take in air?
16. What does your chest measure with the air breathed out?
17. What does it measure expanded?
18. What is the value of a large chest?
19. How may the chest be developed?

CHAPTER XVI

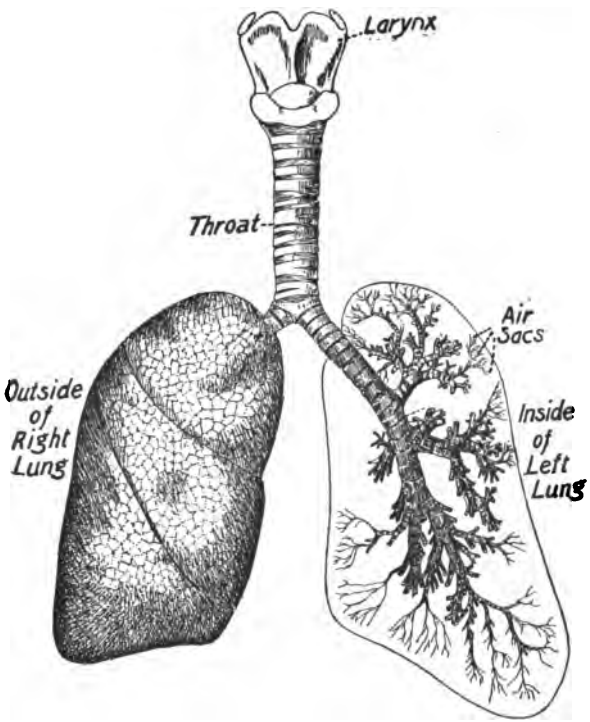
WHAT BREATHING DOES FOR THE BLOOD

The Air Passages. — As we draw in our breath we expand the chest. The air rushes through the nose into the throat and then into the windpipe. At the top of the windpipe, as you know, is the larynx, or "Adam's apple."

By placing thumb and finger upon the outside of the throat, just below the larynx, you can feel the windpipe, and the hard rings which keep it open, so that the air can enter it easily. At the top of the chest the windpipe divides into two branches, one going to each of the lungs. The air passes down the windpipe into the lungs.

The Lungs. — The *lungs*, two in number, are situated in the chest, one on the right side, the other on the left. If you wish to see what they look like, ask a butcher to show you a pair of ox's or sheep's lungs (or "lights" as they call them). You will find that they are pinkish gray in color, are slightly spotted with black, and look somewhat like a sponge.

The Breathing Tree. — To understand just how the air passes in and out of the lungs, let us pretend that the windpipe is the hollowed trunk of



THE BREATHING TREE

a tree, turned upside down in our body. The larynx will be at the root. The trunk, or the windpipe, runs from the throat down to the chest,

and there it divides into two large branches. One branch enters the right lung, the other enters the left lung. In the lungs each branch divides, like the branch of any tree, into smaller branches. These divide into others smaller still. They divide and redivide again and again until they are only the tiniest of branches. They are so small that we could not even see them if we could look inside the lungs. Now comes the most wonderful part of the breathing tree. The trunk of the tree and also its branches are hollow instead of solid. At the end of every little twig or tube there is a tiny air-sac, which, when full of air, is round and firm, like a balloon. When the air goes out (the sac is never quite empty), it partially collapses, like a balloon half full of air.

Let us think how the air goes in and out of the breathing tree, whose hollow trunk is the windpipe and whose branches are in the lungs. Take a long breath and we will see what you do. The chest rises slowly, higher and higher. As it rises, the air is going in through the nose, down the windpipe, and through the two windpipe branches into the lungs. There a bit of air goes into every

tiny tube, and finally into the air sac at its end. When the chest has risen as high as it can go, every sac and every little tube is full of air, much as if every leaf on a tree were a balloon filled with air blown into it through the twigs of the tree. As we send the air out again, the sacs partially collapse and the tubes sink together. The air we send out is impure air.

Besides the tubes and air sacs, all through the lungs are millions of tiny blood vessels, through which the heart is constantly pumping blood, just as it is through other parts of the body. All of these little blood vessels pass into the very walls of the air sacs, and thus come very close to the air itself.

Why the Blood goes to the Lungs. — Why do you suppose the blood must make its way to the walls of the air sacs of the lungs? It does this to get air. While the blood is in the lungs, it becomes *purified*, as we say. When the blood goes to the lungs, it is impure blood; when it goes out from the lungs, it is pure blood. This is what happens: the air in the air sacs and the blood in the tiny vessels in the walls of the

sacs come very close together, so close that the waste gases in the blood go from the blood into the air and with the next breath are carried out of the body.

In the air sacs also, each red corpuscle seizes a bit of the good part of the air, the oxygen. As the blood flows out of the lungs again, these little corpuscles are hurried off, each carrying its load of useful oxygen. They carry the oxygen to the muscles, the brain, and other parts of the body, where the oxygen is needed. Thus the blood that has been through the lungs has been purified. It has given up its waste and has loaded itself with the good part of the air. In other words, the impure blood has been changed to pure blood.

QUESTIONS

1. When we draw in our breath, what happens to the chest?
2. Where are the lungs?
3. How does air get into the lungs?
4. What besides air goes to the air sacs?
5. What happens to the blood in the air sacs?
6. What is pure air called?
7. Why should we breathe only pure air?

CHAPTER XVII

OUTDOOR EXERCISE AND VENTILATION

The Need of Outdoor Exercise. — Out-of-door air is the purest of air. For this reason, we should live in the open air as much as possible. Gypsies

A Sturdy Football Team

are usually healthy and strong, although they are exposed to all sorts of weather. Soldiers in time of war seldom take cold, although they are often

obliged to sleep on wet ground. They keep well because they live out of doors. Such games as golf, tennis, football, and baseball are excellent for young people because they not only give exercise, but *out-of-door* exercise, which means that the player gets long breaths of good air.

Bicycling is fine exercise if the rider sits straight, rides slowly, and stops before he is too tired. Skating and rowing are also good exercises. Every boy and girl who lives near the ocean, a lake, river, or pond should learn to swim. Walking is a good exercise too, because it allows one to take fresh air into the lungs. But a simple walk is hardly sufficient exercise for children, who need something more vigorous. Children should run and jump as well as walk. If we wish the fire in a stove to burn faster, we open the draft and give it more air. Why do we breathe fast when we have been running?

LEARNING TO SWIM

The Need of Ventilation. — It is, however, impossible for us to stay in the open air all the time, especially if we live in a cold climate. Since we must live much of the time in the house, the next best thing is to bring in as much fresh air as possible. If several people in a room keep breathing the same air, and breathing out waste gases, in time the oxygen will be gone, and the room will be full of impurities.

Air that has been breathed is unwholesome and may become poisonous. Some of its good parts have been taken out, and waste material from the blood has gone into it. If we keep on breathing air that has been breathed, we grow drowsy or have headache, and we are in just the condition to catch cold. Impure air usually has more or less dust in it, and it is apt to contain germs of disease.

Have you ever noticed a close, unpleasant smell in the schoolroom as you stepped in from out of doors or from another room? It was because the air was sufficiently impure to be unwholesome. When a number of people stay for some time in the same room, as in school or church, particular

care should be taken to keep the air pure. If there is no special way of ventilating a room, doors may be opened or one or two windows — the windows always at the top for incoming air.

AN OPEN-AIR GYMNASIUM

Stoves help a little to ventilate a room by sucking in air at their drafts and sending it up the chimney; then more air must work in through doors and windows to make up for what passes out. An open grate is an excellent ventilator.

Every one ought to remember that fresh air is

necessary to good health. A house should be thoroughly aired every morning, even in winter, by throwing open the windows for a few minutes. We should be far more afraid of impure air than of drafts. To breathe in a room containing impure air is much more likely to give us a cold than to have a draft blow upon us. Fresh air is particularly needed when we are asleep. We should always have a window of our sleeping room open at night, even in the coldest weather. Out-of-door night air is not injurious. Breathing cold, pure air during the night will make us feel fresh and vigorous in the morning.

QUESTIONS

1. Each person in a room should have thirty cubic feet of air every minute. Get your teacher to tell you how many cubic feet of air your schoolroom holds at a time. Then find out for yourself in how many minutes the air would be impure, if no fresh air came into the schoolroom.
2. What is the best air?
3. Why should we take out-of-door exercise?
4. How may a schoolroom be ventilated?
5. How may a house be ventilated?
6. Why should we be particular to have the air fresh where we sleep?

CHAPTER XVIII

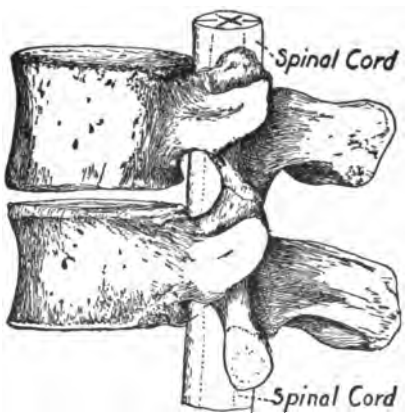
THE FRAMEWORK OF THE BODY

SUPPOSE there were nothing in our bodies but flesh, blood vessels, heart, stomach, and intestines. Suppose, in other words, we had no strong framework to hold us together. We should be somewhat like an earthworm or a jellyfish. The flesh is so soft that it must have a rigid support to hold it up. This support is called the *skeleton.*

The Bones of the Body. — The frame which holds our bodies in place is made of bones. The bones of the human body are similar in color and texture to those of a chicken or an ox. A bone is so hard that it cannot be bent. It is so tough that it is not easily broken. Bones have in them mineral matter to make them hard and animal matter to make them tough.

In the human body there are about two hundred bones of different sizes and shapes. Most of them are held together by *ligaments.* These are white, inelastic bands of small, straight fibers, somewhat like bundles of strong threads.

Running down the back is what is called the *backbone.* It is really a string of twenty-six small bones fastened together. If the backbone were one bone, it would be rigid and likely to break, but being made of so many small ones, it can bend a little in all directions without breaking. By moving your fingers along the backbone above the waist, you can feel the separate little bones. Inside the backbone is a very important part of the body, the *spinal cord.*



TWO OF THE TWENTY-SIX SMALL BONES THAT MAKE UP THE BACKBONE

Showing the spinal cord passing through them

The *skull* is a bony box at the upper end of the backbone. It protects the brain within, and it holds the eyes, ears, nose, and mouth.

The Ribs. — The *ribs* are twenty-four in number — twelve on each side of the *breastbone.* The breastbone begins just below the neck in front. The seven upper ribs on each side, called *true*

ribs, are fastened to the backbone as well as to the breastbone. The two lowest on each side are called *floating ribs*, because they are not connected either with the breastbone or the other ribs. Point out on the diagram the breastbone; the floating ribs; the true ribs. Find the position of your ribs with your fingers. Find the location of the floating ribs. The ribs that arch around to meet the breastbone surround the cavity called the *chest*. Within the chest are the heart and lungs.

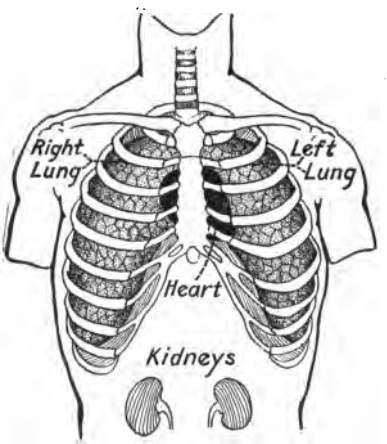
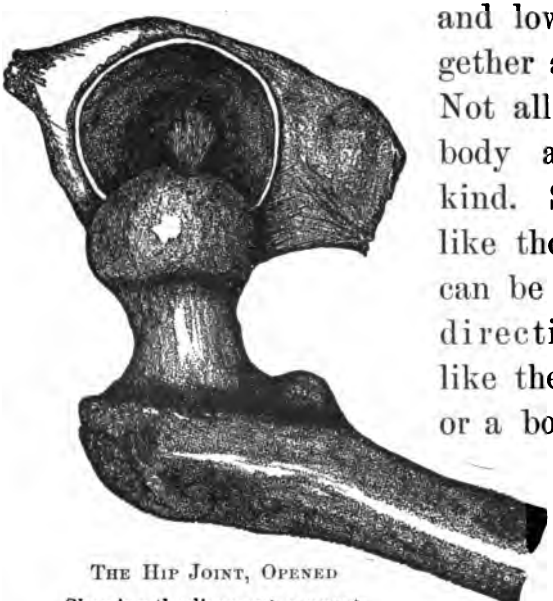


DIAGRAM SHOWING THE POSITION OF THE BREASTBONE AND RIBS; ALSO THE LUNGS, HEART, AND KIDNEYS

The Arm and Hand. — From the top of the chest and on the sides hang the arms. There are several parts to the arm. The upper arm has a single strong bone. The lower or forearm has two bones. The wrist consists of several small bones bound firmly together. The arm ends in the palm of the hand and the fingers. There is a separate

bone between each two finger joints. Has the thumb the same number of bones as each finger?

The Joints. — When two bones come together, they are united by what is called a *joint.* We can bend the arm, because the bones of the upper and lower arm come together at the elbow joint. Not all the joints in the body are of the same kind. Some of the joints, like those at the elbow, can be moved in but one direction. They bend like the hinge on a door or a box, and thus they are called *hinge joints.* Others allow the bones to be turned in any direction. They are *ball-and-socket joints.* The joints of the fingers, the wrist, the elbow, the toes, the ankle, and the knee, are hinge joints. The joints at the shoulder and hip are ball-and-socket joints.



THE HIP JOINT, OPENED
Showing the ligament connecting the ball and socket

Growth of the Bones. — Although bones are hard and tough, they are alive, and they grow. We can see the growth of a child from year to year. The bones of grown people do not grow, but, as you have already learned, they need repair.

A Graceful Body. — Every boy wishes to be strong and manly in appearance; every girl wishes to be graceful. We all admire a well-shaped body and would like to possess one. A well-built, graceful body depends as much upon the position and shape of the bones, as upon beauty of flesh and skin.

If we let our bones grow naturally, they will grow into the proper shape. We can help our bones to grow as they should by giving them the proper building food, and by never compressing the ribs or any part of the body by tight clothing or bands. If we wear tight belts or confine the bones in any way, they will be bent out of shape. For example, if we wear badly shaped or tight shoes, our toes will be misshapen.

We can keep the body straight if we get into the habit of standing, sitting, and sleeping with the body held straight. Stand with *head up*,

chin in, and *chest high*. A person who allows his head to droop forward and his neck to bend becomes round-shouldered. The lungs are compressed in the chest, and ill health may result.

Do not get round-shouldered by leaning over your desk when you study. We admire soldiers because they stand erect. You can be as straight as a soldier if you try.

QUESTIONS

1. What is the skeleton of the human body made of?
2. About how many bones are there in the human body?
3. How are the bones held together?
4. How many separate bones are there in the backbone?
5. Where is the spinal cord?
6. What is the skull? What does it hold?
7. How many ribs have we? To what are they attached?
8. What are the parts of the arm?
9. Name the hinge joints. The ball-and-socket joints.
10. What is meant by the *growth* of the bones in children? In older people?
11. Upon what does grace of body largely depend?
12. How can you help the bones of your body to grow naturally?
13. What is the danger from becoming round-shouldered?

CHAPTER XIX

DISLOCATIONS, SPRAINS, AND FRACTURES

SOMETIMES bones are pulled out of position at a joint. We call this a *dislocation.* Sometimes a joint is strained so that a few of the small bands, or ligaments, connecting the bones are torn. We call this a *sprain.* Occasionally a bone receives a blow or wrench sufficiently hard to break it. We call this a *fracture.*

Dislocation. — In the case of a dislocation, the bone wrenched out of place must be put back in its proper position before we can move it in the usual way. This should be done by a physician, unless some one happens to be present at the time of the accident, who understands *perfectly* how to put the bone back in its proper place.

Sprain. — When any one has the misfortune to sprain a joint, it is wise to have a physician examine the sprain. Strips of cloth kept wet with cold water or alcohol and wound tightly about the joint will relieve the pain until the doctor arrives. If no doctor is within call, the joint should be

bathed first with very hot water and then w cold. Pouring the water over the sprain is st better than bathing it. After the pain is relieved, bind up the joint tightly with bandages soaked in alcohol, witch-hazel, or any good liniment. For the first day or two after the accident the joint should be kept very quiet. After that it should be used a little every day to prevent lameness.

Fracture. — In the case of a fracture, the bone will mend itself in time, if it is properly set. This, of course, should be done by a surgeon. To set a bone, the two parts are brought together, exactly as they were before they were broken. The arm or leg is then bound firmly to a piece of wood or put in a plaster cast to hold the bone in place until the parts have grown together again. This takes from six weeks to two months, or even more in the case of a severe break.

QUESTIONS

1. What is a dislocation?
2. What is a sprain?
3. What must be done to a bone that has been dislocated?
4. How should a sprain be treated?
5. What is a fracture?
6. How is it mended?

CHAPTER XX

HOW WE MOVE

TAKE a bean bag or a ball and throw it. If you had no bones, you could not have thrown the ball, but the bones alone could not have thrown it. Take the ball into your hand once more and put yourself into position for throwing it. Notice your right arm. Is it stiff and straight like the left one? Your left leg is straight and pushes against the floor. The right leg is slightly bent. The body is stiffened. You could not have taken this position if you had no bones; much less if you had no muscles.

BOY PUTTING BALL

The Formation of the Muscles. — The lean meat of an ox or a sheep is made up of some of the muscles of the animal. The lean meat or the flesh of our bodies forms the muscles. If you grasp your upper arm tightly, you can feel the bone. If you lay your hand lightly upon the arm, you feel only the muscle of the arm. There

are muscles in all parts of the body. The muscles of the human body number about five hundred, and form more than one half the body. They use up a large part of the building food we eat.

Muscles have the power of shortening and of being stretched out again. When they shorten or contract, they move the bones to which they are attached. When you clench your fist and bend your arm, the muscles of the upper arm contract. When you lift your leg to take a step, you contract the muscles of the leg and thus move the bones.

THE MUSCLES OF THE ARM, ENDING IN THE WHITE TENDONS AT THE WRIST

The Voluntary and Involuntary Muscles. — Some of the muscles we can move at will; they are called *voluntary* muscles. Some of them move without effort or control on our part; they are called *involuntary* muscles. There are also certain muscles that are partly voluntary and partly involuntary; that is, we can move them at will, but they can move without attention on

our part. We move our head, our arms, our legs, our fingers, and our toes as we like, using voluntary muscles. The muscles of the stomach push the food around inside without our being even conscious of the fact that they move. The muscles of the stomach are thus involuntary. We can close our eyes by shutting down the lids whenever we please, but we wink constantly without noticing the fact.

The Tendons. — The muscles of the body are what give us motion. Most of them are long masses of flesh attached to bones. They are usually larger in the middle than at the ends, and each is attached to two bones by cords called *tendons*. Grasp your left wrist, and then open and close the fingers of the left hand several times. You can feel the tendons at the wrist as the fingers move. The muscles that move the fingers are in the arm below the elbow. You can feel them by grasping the arm below the elbow and then opening and shutting the fingers. These muscles are connected with the fingers by the long tendons which you felt at the wrist.

The strongest tendon in the body is at the heel, the *tendo Achillis*, or the *tendon of Achilles*.

If you are familiar with the old Greek stories, you will see why the tendon has this name. You remember that the promise was made to Achilles' mother that if her child was dipped in the river Styx, he could not be wounded in battle. So she picked up the baby *by the heel* and dipped him into the river. He was wet all over except on the heel. Years later the warrior was killed, shot through that very heel by a poisoned arrow.

SIDE VIEW OF THE BONES OF THE FOOT
T is the *tendo Achillis*

QUESTIONS

1. What is the color of muscle?
2. Where are our muscles found? To what are they attached?
3. How many muscles are there in the human body?
4. How do the muscles move our bones?
5. What is the difference between voluntary and involuntary muscles?
6. What are tendons? What is the strongest tendon called?
7. Find in what parts of the body you are using muscles when you walk.
8. Find in what parts of the body you are using muscles when you write on the blackboard; when you hold a book to read; when you lift a chair; when you run; when you sing.

CHAPTER XXI

HOW TO STRENGTHEN THE MUSCLES

EVERY one wishes to be strong. Boys like to show the large, hard muscle of the upper arm. They like to show how fast they can run or how much they can lift. Girls, as a rule, do not care so much for this sort of strength, but they ought to, for strong muscles help a person to work well and to play well.

You have already learned that you can strengthen the muscles by eating good building foods. Some people think they can make their muscles stronger by taking what they call a *stimulant*, that is, some kind of an alcoholic drink. This is a mistake. Alcohol tends to weaken the muscles rather than to strengthen them. The boy who takes alcohol in any form will never be the athlete he may be if he takes only nourishing food and plenty of outdoor exercise.

Using the Muscles. — The more you use your muscles, the stronger they grow. You would find it difficult to lift anything heavier than your

own weight, yet the trained athlete at the circus holds half a dozen men at one time by poise and strength of muscle.

So, as we use our muscles, they grow stronger. If, on the other hand, we do not keep our muscles at work, they grow weaker. Little babies have muscles by which they can move their toes much as you can your fingers. After their feet have been confined in shoes for a few years, these muscles lose their strength, until they are of very little use. If you had used your toes as you have used your fingers, instead of shutting them up in shoes, you would be able to pick things up from the floor with your toes.

It is the same with all the muscles. Young children are so active that they keep nearly all their muscles in use, but when they get older they think that such things as running and jumping are undignified. The result is that their muscles lose much of their grace and quickness of movement.

If we wish to be strong, we must *use our muscles.* If we wish to be graceful, we must *use them all.* We should be careful not to use the same muscles all the time. After skating for a time, the muscles

of the legs become tired. Go into the house and practise on the piano for a while, and in a short time you have forgotten that your legs ached when you went in. Keep up the piano practice too

A Gymnasium equipped for many Kinds of Exercise

long and the shoulders get tired. Each kind of exercise should be taken in a moderate amount.

Exercise. — There are many ways of taking exercise, some of which are play and some work. The best kind of exercise is something that keeps

you moving very actively and that you enjoy doing. This will keep both your muscles and your mind busy. This is the reason why games are so useful for children, and why hard and exciting games, if not kept up too long, are better than easy and quiet ones. Outdoor exercise makes children stronger, more healthy, and brighter scholars. This is true of both girls and boys.

STRENGTHENING THE MUSCLES BY THE USE OF INDIAN CLUBS

QUESTIONS

1. Of what use are strong muscles?
2. Does alcohol weaken or strengthen the muscles?
3. What kind of food do the muscles need?
4. What besides the proper food helps the muscles to grow strong?
5. What happens if you use only one set of muscles all the time?
6. What is the best kind of exercise for boys and girls?

CHAPTER XXII

THE COVERING OF THE BODY

The Outer and Inner Skin. — The body is covered with *skin*. It consists of two parts, an *outer* and an *inner* skin. The outer skin is constantly wearing away, while new skin grows underneath. The outer skin peels off in little scales. We call the scales that peel from the top of the head, and thus are caught and held by the hair, *dandruff*. The outer skin is not sensitive, and there are no blood vessels in it. The skin about the base of the finger nails and toe nails is outer skin. If you stick a pin through this skin, it will cause no pain.

The inner skin is under the outer layer of skin and is much thicker. It is very sensitive. It is full of blood vessels and will bleed if it is cut.

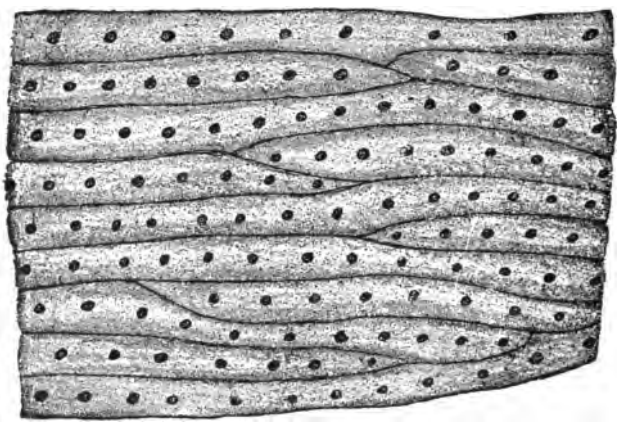
The skin is much thicker in some places than in others. In some places the skin is stretched tightly over the bones or flesh, as on the top of the head, the palm of the hand, and the knee. In others it is so loose that it can easily be

pinched up with the fingers, as on the back of the hand, the upper arm, the cheek, and the ankle.

Duties of the Skin. — The skin serves as a protection. The flesh and other parts beneath are very delicate and need to be kept from injury. The tough skin does this protecting work. Have you noticed that when you have played baseball for a few weeks you have hard places on the inside of your hand? If you have ever been barefoot for a few days at a time in the summer, you have found similar places on your feet. These hard spots (called *callosities*) are places where the skin has grown thick to protect the parts beneath from injury. Were it not for such hardening, the blows of the hard ball might injure the hands. The gravel would be apt to cut or wound the bare feet.

One of the most important duties of the skin is to keep out from the body the minute disease germs that are so often in the air. These might injure us if they should get into the body. Sometimes, when we have cut or bruised the skin, such germs do make their way in. The wound then becomes inflamed and very sore. To avoid

this danger so far as possible, all cuts and bruises, as you have already been told, should be washed with *clean* water and then bandaged with a *clean* cloth. This is especially important if the skin is



THE SURFACE OF THE SKIN
Highly magnified, showing the pores

not quite clean, for some of the most dangerous germs live in dirt.

The Pores of the Skin. — Hold your finger close to a piece of cold glass. Notice the drops of water that collect on the glass. Where do they come from? As you have already learned, a large amount of water is given out through the skin. Look closely at the skin of the fingers.

You will notice that there are a great number of ridges. Along the top of each ridge there is a row of tiny holes, too small to be seen without a magnifying glass. They are called *pores*, and they lead into little tubes which come from *sweat glands*.

The Sweat Glands. — There are more than two million *sweat glands* in our skin. They are constantly taking water from the blood and pouring it out on the surface of the skin, where it generally dries and disappears. For this reason we fail to notice it. When we work or play hard, or the weather is warm, moisture comes through the skin so fast that it collects in drops. We then say that we are *perspiring*, but we are really perspiring all the time. If for any reason moisture fails to come through the skin, we become ill at once. When a person has fever, his skin is dry and hot; that is, he is not perspiring properly.

Some furnaces are so arranged that when they reach a certain degree of heat the draft shuts of itself. When the fire has cooled to a certain degree, the draft opens again. The skin serves a somewhat similar service for our bodies. The skin, in other words, acts as a heat regulator.

Although we perspire most when we are hot, the perspiring does not make us warm, but, on the contrary, actually cools us off.

If there were not some way of regulating the heat, we should grow very warm on warm days and very cold on cold days. If we work hard, we get warmer, because we are burning up more food. The hot blood then flows quickly to the skin to cool off. Have you noticed how red a person's skin becomes when he is working hard? This is because the warm blood is flowing through it to get cooled. On the other hand, if the room or the air is cold and the body is chilled, less blood goes to the skin. Thus it does not get cooled, and the heat is kept in the body. The process is somewhat like the regulating of the heat in a room by opening and shutting a window. If the body gets too hot, the hot blood goes to the skin, and the sweat pours out upon it, thus cooling us off, just as the window is opened when the room is overheated. If the body is cool, the blood goes slowly to the skin, and the sweating partly stops, just as the window is closed again when the room is cold. In this way the heat of the

body is almost the same in winter and in summer, no matter what the air outside may be.

The Hair an Aid to the Skin. — The *hair* helps the skin to protect our bodies. Hair grows on all parts of the body except the palms of the hands and the soles of the feet. Each hair has at its root a little *oil gland*, which secretes oil enough to keep the hair soft. It is, therefore, not necessary to use hair oil, although after washing the hair with soap a little vaseline rubbed into the roots is good.

The Nails. — The finger and toe nails are, like the hair, a peculiar form of growth of the skin. They are, in fact, parts of the skin, and protect the ends of the fingers and toes from injury. If a nail is injured, a new one grows in its place.

The Skin and the Kidneys. — The body gets rid of part of its impurities through the skin. In addition, there are two important organs whose work it is to clear the body of the impurities of which the skin cannot get rid. They are called the *kidneys*. They are a pair of bean-shaped bodies, though much larger than beans, each kidney being some four inches long and one

and a half inches wide. They are located one on either side of the backbone about three fourths of the way down. (See cut, p. 94.) They remove a large amount of waste water and other waste materials from the body. The kidneys and the skin aid each other in keeping the body free from impurities.

A KIDNEY

A, an artery; *V*, a vein; *D*, the duct that carries part of the waste material from the body

QUESTIONS

1. With what is the body covered?
2. What two kinds of skin have we?
3. What is dandruff?
4. How does the skin serve as a protection to the body?
5. What are callosities?
6. Where are the pores of the skin?
7. How does the skin help to regulate the heat of the body?
8. Of what use is hair to the body?
9. What keeps the hair soft?
10. What are the nails? What purpose do they serve?
11. What organs aid the skin in keeping the body free from impurities? Where are they located?

CHAPTER XXIII

HOW TO CARE FOR THE SKIN

SINCE the skin has so many duties to perform it should be well cared for. If we allow it to become injured, it grows inflamed and gives us pain. If we allow it to get sluggish, perhaps by wearing too much clothing, we not only suffer from cold but we "catch cold" easily, and may become ill. If we rub the skin too hard, when it is not toughened by use, it becomes blistered. If it is not kept clean, it will become rough and unsightly. How shall we take care of the skin?

Toughening the Skin. — When you study Latin you will probably read Cæsar's account of the wars in the part of Europe known in his day as Gaul. Cæsar tells us that the Germans who lived beside the river Rhine used to bathe in the river every morning. Even in the coldest days of winter they would break the ice and plunge into the icy water for their daily bath. They were able to do this because from childhood they had kept the skin of their bodies tough.

We ourselves should not consider it a very

great feat to wash our face and hands in ice-cold water. Boys and girls who are so *fortunate as to sleep in unheated rooms*, and have a window open at night, sometimes find ice in their water pitchers when they dress in the morning. With practice we could get the skin all over the body as tough as that on our face and hands.

The more we can toughen the skin, the less likely we are to take cold. Yet in our cold climate, living as we do in very warm rooms, it is not safe for us to try the old German way of toughening ourselves. These Germans lived out of doors in all weathers, day and night. As a result, they could endure the exposure that would cause the death of people who live as we do nowadays.

Bathing the Skin. — Baths help us to keep the skin healthy and active. An active skin is one through which the blood flows briskly, and in which the pores or sweat glands are free and vigorous. Baths both clean and stimulate the skin. If we do not bathe frequently, the body acquires an unpleasant odor. The dirt and the waste matter from the body that collect in the

skin need to be washed off, for the sake both of looks and of health. The bath is more important as a means of stimulating the skin than for mere cleanliness. A bath in *cold water*, or a cold sponge or shower bath, followed by vigorous rubbing, is specially useful for this purpose. This has the same effect on the skin that exercise has upon the muscles. It makes the skin active and strong. Before breakfast is a good time for a cold bath, but it may be taken at night.

A warm bath cleans the skin but does not stimulate it. Cold baths are strengthening; hot baths may be weakening. A person who takes a cold sponge bath every morning is not liable to catch cold. If you acquire this habit while you are a child, it will keep you from much illness after you grow up. If you find that it takes considerable courage to put the cold water upon your skin in winter, wet just a few inches at a time — say an arm or one shoulder — then rub the part until it is aglow. It is a good plan to first dry the body with a linen towel, and then rub it with a bath towel. When your body has been bathed and rubbed in this way, the blood will be hurrying

through your veins, the skin will be in a glow, and you will be in splendid condition to begin the day. Air baths are always useful in keeping the skin vigorous. To take air baths, one need simply remove the clothing so as to expose the skin to the air. The body should afterwards be rubbed quickly with a bath towel.

The Care of the Nails. — The finger nails should be kept short enough so that there is no danger of their breaking. They should not, however, be cut or filed down to the *quick*, that is, to the tender part under the nail. The nails should never be bitten, for this habit is not only vulgar but injurious to the nails. The nails should be kept clean. If dirt is allowed to collect under them the beauty of the hands is spoiled. Clean, daintily cared-for finger nails add greatly to a boy's or girl's attractive appearance.

Clothing. The Best Kind to Wear. — We wear clothing both for comfort and for adornment. Clothes do not make us warm, but they keep the heat of our bodies from passing out into the air. Clothing should be dark colored and heavy in winter. It should be light in both color and

weight in summer. Light colors shed heat and dark colors hold it. Can you see why white is the best color for summer and the least desirable for winter?

It is wise always to wear a woolen garment next the skin in winter, because wool is warmer than cotton and protects us from the cold. Wool may be worn in summer, also, if worn loosely. It then absorbs the perspiration and protects us from a sudden change in temperature. The clothing worn next the body should be changed often. It should always be removed at night, so that it may become dry and be aired while we are asleep.

It is unwise to wear furs and heavy wraps around the neck, for it makes the skin tender and we are more liable to catch cold. Leggings will protect the legs, so that children can play in the snow without danger of catching cold. Rubbers or rubber boots should be worn in wet weather. We wear hats in summer to protect us from the heat, and we wear hats in winter to protect us from the cold.

The Color of the Skin. — Sick people almost always have a pale skin, because they are shut

ALL READY FOR WINTER SPORT

up in the house. Boys and girls who play out of doors in all kinds of weather have rosy cheeks. When we are out in the warm sunshine we become tanned, that is, the heat turns the skin brown. In other words, heat, cold, exercise, and *lack* of exercise, affect the color of the skin.

QUESTIONS

1. Why is it necessary to take special care of the skin?
2. What is the value of toughening the skin?
3. Should you sleep in a room with the heat turned on or the window closed? Give the reasons for your answer.
4. Why is frequent bathing important?
5. What is the effect of a cold bath on the skin? A hot bath?
6. What kind of clothing should you wear in winter? in summer? Why?
7. Why do we wear shoes? Why do our shoes have stiff soles? Why are the upper parts of the shoes made of soft leather? Why do we wear gloves? Which keeps the fingers warmer, gloves or mittens? Can you think why?
8. Why do we put on extra clothing when we go out of doors? Why do we carry umbrellas when it rains? and also when the sun shines?
9. What gives the skin a healthy, rosy color?
10. How much of the day do you spend out of doors?

CHAPTER XXIV

INJURIES TO THE SKIN

From the Cold. — Once in a while, on a very cold morning, the finger or toe gets frozen, without the person's even realizing how chilled the part has become. If, some day when you reach school, somebody should tell you that your nose or ear is frozen, go out of doors at once. Have a boy or girl rub the frozen place with snow, if there is snow on the ground, or, at any rate, thaw out the place gradually. The blood will then begin to flow again slowly, and the frozen member will be restored to its normal condition. If a frozen place is thawed quickly beside the fire, it is liable to become inflamed afterwards and to give great trouble.

Chilblains, from which children so often suffer in cold weather, are caused by the continued heating and chilling of the toes and heels. The difficulty may be prevented by wearing warm stockings and loose, thick shoes. Children who suffer from chilblains should bathe the feet with cold water every morning and every night during

the winter. Cold water will relieve the itching and burning for the time.

From Fire. — If the skin comes into contact with fire, or anything that is hot, it is burned. The burned place becomes inflamed and painful, and sometimes a blister is formed. For a slight burn, applications of cold water will usually give relief. A tablespoonful of cooking soda dissolved in a teacupful of water may be used for wetting cloths to place on the burn. If the pain is severe, after the first burning sensation is relieved, cover the place with vaseline. Renew the vaseline until the skin is healed.

Wounds made with the toy pistols used so often on the Fourth of July are very dangerous. Many children have lost their lives from such wounds. If you wish to shoot off caps on the Fourth of July, or at any other time, use some other kind of instrument than a toy pistol.

Blisters. — If a part of the skin receives too severe treatment, as you have already learned, a blister forms, — that is, the outer skin separates from the inner skin, and a little watery liquid collects between the two. The blister warns us

by its soreness that we must be more careful until the skin has healed once more. Sometimes the blister breaks. When this happens, you can see the pink or inner skin below the outer skin.

Corns. — If the shoes press too tightly upon the toes, the skin is apt to grow into a thick bunch, which may become painful. We call such a bunch a *corn.* The way to avoid having corns is to wear properly fitting shoes, — neither too loose nor too tight.

Warts. — Sometimes the skin grows into little bunches called *warts.* If we let them alone, they will go away of themselves after a while. They are never caused by handling toads. They cannot be driven away by marking notches in a stick, by rubbing them with raw beef, or by saying any rhymes or incantations.

QUESTIONS

1. How should a part of the body that has been frozen be treated?
2. How can chilblains be helped?
3. What can you do to relieve a burn?
4. What is a blister?
5. Why are tight shoes injurious to the feet?
6. What is a wart?

CHAPTER XXV

HOW THE BODY IS CONTROLLED

SUPPOSE you sit still for a minute. What have you been doing in this time? Your heart was beating and the blood was circulating through the body. Very likely your stomach was digesting food, and the blood was taking some of it as it passed through the intestines. You breathed twenty times or more, taking in fresh air and sending out poisonous gas. You winked every two or three seconds, and probably you moved your hands and feet once or twice, besides swallowing, and rolling your tongue. With all these complicated actions going on at once there was no mistake and no confusion. When you meant to move a hand you did not make a mistake and move the tongue, nor did the heart pump to some other part of the body the blood that was needed in the stomach.

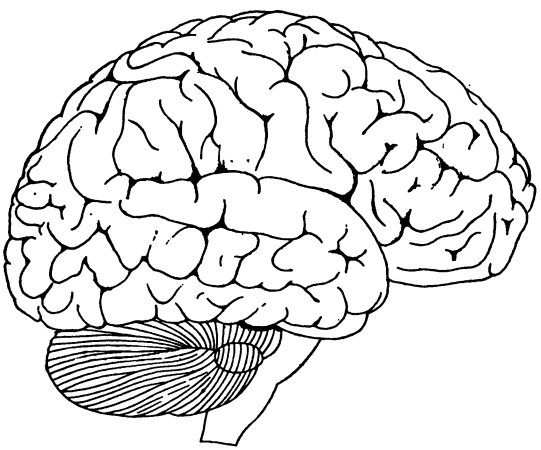
There was something else that you were doing in the minute while you were sitting still. You were *thinking.* You may have been thinking of your lessons, or of what games you would play

at recess, or of what you would have for dinner, or of all these things one after the other, and of several others besides. When we are awake, we are constantly thinking of something. It is because we all have in us the power to think, that we can do and say what we like.

The Mind and the Brain. — The thinking part of us we call the *mind.* What makes the muscles contract so as to move our legs when we wish to walk? What causes our hands to move so that we may pick up food and put it into our mouths when we are hungry? It is the mind, working through the brain, that does these things. It is the mind that makes all the actions of the body go on and keeps them moving in harmony.

The *brain* is the home of the mind. That is why the brain is called the king of the body. We think that we should like to run across the school yard at recess. Instantly King Brain orders our muscles to contract and off we go. We think it is time to study. The brain makes our feet walk to the desk, our hands pick up the book and open it, and our minds to begin to learn the lesson.

The Formation and Power of the Brain. — The brain is shut up in the tight, bony box called the *skull*, and is formed of a rather soft substance. The outside surface is not smooth like a ball, but



THE BRAIN

is covered with small ridges and deep ditches, known as *convolutions*. The two sides of the brain are separated by a deep groove. The sides are called hemispheres. Can you guess why they have this name?

The human brain is the most wonderful thing on the earth. It is because our brains are more highly developed than those of other animals

that we can accomplish so much more than they. Man has brains so developed that he can think out and plan what is new. Thus we wear clothing of woven cloth. We speed over the land in railroad trains and cross the ocean in steamboats.

The Activity of the Brain. — The brain, like the heart, is always at work. When we are asleep, however, it does not work nearly so hard as when we are awake. The duties of the brain are of three kinds. In the first place it receives reports from its messengers, which tell it what is going on outside of the brain box. After receiving the reports, it decides what should be done, and after deciding what is to be done the brain sends messages to the muscles, telling them what to do. The brain is all the time working in this way, although we scarcely notice it.

The brain and its helpers are like a telegraph system. The brain itself is the operator, which is constantly sending messages to this or that muscle, or to hundreds all at once. A telegram passes to its destination through wires strung on poles. A message from the brain passes to the muscles by means of tiny white cords, called *nerves*.

The brain is connected with every part of the body by these nerves. If you prick your finger, you feel pain. The pin touched a nerve. The nerve instantly sent a message to the brain, and the pain was the result. It is because of the brain and its nerve messengers that we feel heat, cold, and pain, and that we see, hear, taste, and smell.

QUESTIONS

1. Can you sit so still that your body will make no movement at all?
2. What is the thinking part of us called?
3. Where is the brain located?
4. What are convolutions?
5. Why can we do so many more things than other animals?
6. What are the three duties of the brain?
7. How does the brain send its messages to the various parts of the body?
8. What two kinds of actions do we perform?

CHAPTER XXVI

THE CARE OF THE BRAIN

Work. — We have learned that we must use our muscles if we wish them to grow strong. The brain, too, grows stronger by use. When you first went to school, you found it hard to remember how to spell the simplest words. Now you can read without thinking that it is difficult. When you first succeeded in adding a simple sum like 2 plus 3, you felt that you had performed quite a feat. It seems very easy compared with the examples you are working now. Children go to school that their brains may have the opportunity to think. The better the brain is trained to do one thing at a time, the better it will serve us. The better servant we train our brain to be, the more useful men and women we shall become. Keep the brain busy.

Recreation. — "All work and no play makes Jack a dull boy," however. In order to keep his brain and nerves healthy, "Jack" must also have recreation, or play.

Games are the best form of recreation for chil-

dren. When we play active games, we use the muscles, and we receive such enjoyment that we rest our brains. Besides, we must learn to think quickly, if we are to win, and quick decisions mean a useful brain. It is by trying earnestly to win in the games we play that we enjoy them most. Reading is also an excellent recreation. It gives pleasure and at the same time is exercising the brain.

Sleep. — The brain never rests entirely, but it is relieved of much of its work when we sleep. The heart beats, and there is more or less movement of the muscles at all times, but we are not thinking, talking, moving about, or working when we are asleep. "Early to bed and early to rise, makes a man healthy, wealthy, and wise," so the old saying goes. We know that it makes him healthy, if he does not rise *too* early. How do you suppose that it might also make him wealthy and wise?

You should not try to study or work when you are sleepy. The lessons that you try to learn then you do not remember. It is better to leave them and go to bed. You can rise a little earlier than

usual and do the studying in the morning when you are fresh and can think quickly.

Sometimes, when we have eaten too hearty a meal at night, or when we are particularly tired, we do not sleep as well as usual. Instead of resting quietly, the brain is still somewhat active, and we dream. In the daytime when we think, our thoughts are sensible. We are thinking about things in which we are interested, as our lessons and our plays. When we dream, our brains are partly active and partly resting. The dreams are mixed-up thoughts, and consequently are often absurd. You can see how ridiculous it is to put any faith in what we dream. If a dream happens to come true, this is a mere coincidence. The dream was only a half-thought, coming from a brain that was trying to rest and could not do so completely.

Habits. — The brain continues to act in accordance with the training it has received. If we learn to do a thing in one way, the brain tends to keep on doing it in the same way. *Habits* are our servants. If we have servants, we want good ones. We ought to be careful to learn to do

things well while we are children, and then we shall have well-trained servants all our lives. We should get into the habit of sitting and standing straight. We should make it a habit to take regular exercise. We should always tell the truth. We should work hard when we work and play hard when we play. We should always be kind and speak pleasantly. If we form such good habits now, they will always stay with us, and will make our lives happier and better.

Going to bed at a regular time every night, having our meals at regular times every day, studying at regular hours, and performing cheerfully and without being told whatever duties about the house may fall to our share — all these are splendid habits.

Use of Narcotics. — There are certain drugs that put the brain to sleep. This is an unnatural sleep and very harmful. Such drugs are called *narcotics.* Opium and paregoric are narcotics.

Alcohol is a narcotic which is used even more commonly than opium. *Drinks that contain alcohol, such as beer, wine, ale, and whisky, dull the mind,* so that the person who gets the habit

of taking them cannot think clearly. Alcohol may weaken the muscles and deprive the brain of its control over them. The person thus loses control over himself more and more as he increases the use of alcohol. It may finally be the means of his death.

Sometimes children learn to drink beer because they think it will make them strong or because some older person urges them to take it. It does not make them strong, and by learning to use alcoholic drinks they are forming a habit that is likely to injure or even ruin their lives. It does not make a boy manly to take strong drink, nor does it make him a man more quickly. It really keeps him a boy longer, because it keeps his brain from developing. Thus alcoholic drinks are particularly harmful for children.

Use of Cigarettes. — Tobacco, also, has a bad effect on the brain. The boy who learns to smoke cigarettes loses his brightness and is almost sure to become a poor scholar. If you want to become a strong man, let cigarettes and all forms of tobacco alone. Cigarette smokers are usually neither bright scholars nor good athletes.

The keen, strong, healthy man is the man who succeeds in life. To be strong and capable you must have a clear brain. Train your mind by faithful study, strengthen it by work; keep it bright by sleep and recreation. Then, if you do not let it be injured by alcohol or tobacco, if you keep it healthy, you will have a capable brain, and this will help you to be also "wealthy and wise."

QUESTIONS

1. Why should we keep our brains busy?
2. What do we mean by recreation?
3. Why is it necessary for girls and boys to play as well as work?
4. How much sleep do children need?
5. What are dreams? Should you place any faith in them?
6. What is a habit?
7. Name ten good habits easily formed.
8. Have you formed them?
9. What is a narcotic?
10. Why should you let narcotics alone?
11. What happens to the brain of the boy who smokes cigarettes?
12. How can you train your mind? How can you strengthen it? How can you keep it bright and active?

CHAPTER XXVII

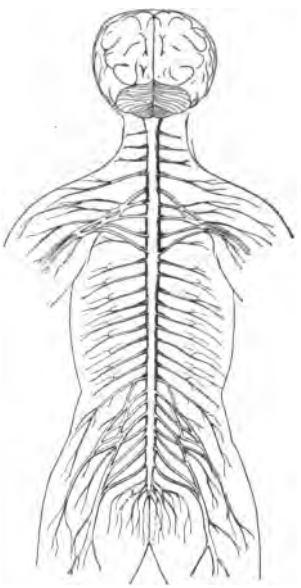
THE BRAIN'S MESSENGERS

On a pleasant, sunny morning in spring, we enjoy walking through the meadows and fields. The air is warm, and perhaps there is a gentle breeze. The sky is a beautiful blue, and the trees and grass are moist with the dewdrops that glisten so brightly in the rays of the sun. The birds are singing their merriest songs. The air is sweet with the odor of the wild flowers growing beside the path. We perceive all these good things as we take our walk, and are glad.

How do we know that the air is warm? What tells us that the grass is green and the sky blue? We know that the birds are singing, but how? It is by the aid of the brain and its messengers that we learn all we know of the outside world.

The Nerves. — You may wonder how the brain, shut up in its dark box, the skull, can know what is going on in the world. It learns these things from its messengers. The white threads, or *nerves*, extend from the brain all over the body. One large bundle of nerves runs down the back. It

is called the *spinal cord.* Hundreds of smaller nerves branch off from the cord and run into every part of the body. Some of the nerves go to the muscles, others to the skin. There is not a spot as large as the head of a pin where there is not at least one nerve. If some of the nerves are cut, the brain cannot send orders to that part of the body to make the muscles obey.



THE NERVOUS SYSTEM
Showing the brain and the spinal cord with its nerves

Kinds of Nerves. — The nerves have many different messages to carry, but the messengers themselves are of two general kinds. One kind carries commands to the different organs. These are called the *motor*, or moving, nerves. When the brain wishes the fingers to be moved, it sends an order down the motor nerves and the muscles instantly obey. If a motor nerve should be cut, the muscle which it enters could not be moved.

The other kind of nerves carries messages from the body to the brain. These are called *sensory* nerves. If you pinch your finger, a message passes along the sensory nerves to tell the brain about it. If the sensory nerves of the finger were cut, we might pinch as hard as we could without feeling any pain. We speak of the messages which the brain receives by way of the sensory nerves as the *senses.* We usually say that there are five senses. They are *touch, sight, hearing, taste,* and *smell.*

The Sense of Touch or Feeling. — Touch your skin in several places with the point of a pin. Can you find any spot that does not feel the point? Wherever you feel the pin, there must be a nerve to take the message to the brain. You can see how numerous the nerves of touch are. Some points of the skin are more sensitive to touch than others. You do not feel the touch until the message reaches the brain. It is not the finger that feels, but the brain.

The sense of touch tells us whether objects are hard or soft, smooth or rough, and whether they are pressing the skin forcibly or gently.

If an object presses the skin too hard for comfort, the message that goes to the brain causes pain. If anything is injuring our body, we are almost sure to have a feeling of pain. We are warned by the pain that something is wrong. Without the feeling of pain, children would often burn their fingers on the stove. Since the heat makes the child feel pain, he learns to keep his fingers away from the fire.

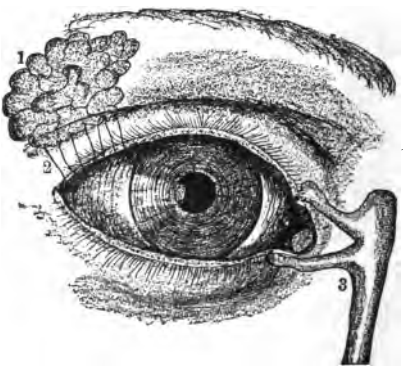
The Sense of Sight. — *The Eyes.* — Seeing makes it possible for the brain to know what is going on outside of the body, even at a long distance away.

The eye is a wonderful, but very delicate organ. The round part of the eye is the *eyeball;* the circle of color is the *iris,* and the black spot in the center of the iris is the *pupil.* When we look toward a bright light, the pupil grows smaller. When we are in a place that is partly dark, the pupil grows larger, in order that more light may get into the eye.

The eye is very carefully protected from injury by a little curtain of skin, called the *eyelid,* and by a fringe of curved hairs on the edges of the eyelids, called the *lashes.* Both the eyelids and

the lashes help to keep out any little particles or insects that might get into the eye and injure it.

The *tear gland* is just above the outer angle of the eye. It secretes tears very slowly all the time, but usually the salty tears run down into the nose. When we cry, or when anything gets into the eye, the tears are secreted faster than at other times, and thus they flow out and down the cheeks.



FRONT VIEW OF THE RIGHT EYE

1, the tear gland; 2, the ducts that carry the tears to the eyeball; 3, the duct that carries the tears to the nose

A special nerve, called the *optic nerve*, carries messages from the eye to the brain. Thus it is the brain that really sees what is outside the body.

The Sense of Hearing. — *The Ears.* — The sense of hearing tells us by the sound that comes to us what is going on outside of our bodies. Our *real* ears are inside of the head, where they are protected by the skull, but where we cannot see

them. What we call the ear is only a piece of skin and cartilage, or soft bone, that serves as a kind of trumpet to make sounds louder. The opening in the middle of the trumpet leads into a tube that passes to the real ear inside the head. A little inside of the opening, a thin skin is stretched tightly across this tube. It is called the *ear drum.* If the drum is injured, the person sometimes becomes deaf. The membrane is very delicate and for this reason it is unsafe to push any hard object into the ear. Very loud noises close to the ear are liable to injure the hearing. For this reason men who fire off cannon put cotton into the ears to deaden the sound.

It is by hearing that we understand what another person says to us. As some persons hear less clearly than others, we should learn to speak clearly and distinctly, so that we may be understood. A person who speaks distinctly is more readily understood than one who speaks in a loud tone of voice.

The Sense of Taste. — *The Tongue.* — The sense of taste is located in the mouth. We know by the taste whether what we take into the mouth

is pleasant or not. In this way, we can usually judge what should and what should not be eaten. Whatever tastes really bad is usually not fit to eat.

Children are sometimes fussy about their food, and because they do not *like* the taste of certain things particularly, they are unwilling to eat what is wholesome. Remember that the taste can be cultivated, that is, we can make ourselves really enjoy food that at first we dislike. Most people have to learn to like a few kinds of food, such as oysters, tomatoes, and olives. If you wish to be an agreeable guest at the home table or at the table of your friends, you will learn to eat whatever is set before you, refusing nothing that is healthful.

The Sense of Smell. — *The Nose.* — The sense of smell is located in the nose. We smell by sniffing air into the nose. We smell only gases. If a liquid or a solid body has an odor, it is because it gives off vapors or gases, and these pass into the nose. The sense of smell is of use in warning us of the presence of injurious gases in the air.

QUESTIONS

1. How do messages go to and from the brain?
2. What is the spinal cord?
3. Which way do the motor nerves carry messages?
4. Which way do the sensory nerves carry messages?
5. What are the five senses?
6. When do we feel pain? Why do we feel pain?
7. What are the parts of the eye? Are eyes all the same color?
8. What happens to the pupil when we look toward the light? What closes over a part of the pupil?
9. How are the eyes kept clean?
10. Where are the ears?
11. What is the ear drum?
12. Of what use is the sense of hearing?
13. Where is the sense of taste located?
14. Why should we cultivate our taste?
15. What is meant by the sense of smell?

ACTION LESSON

1. Touch the finger tips, the back of the hand, the forehead, the elbow, to various objects to find where the skin is most sensitive to touch. Feel some object that is hard; something soft; something smooth; something rough.
2. Write a word on the blackboard. How far away can you read it?
3. Find how far from the ear you can hear a watch tick.
4. Name ten objects, the smell of which is pleasant.

CHAPTER XXVIII

THE CARE OF THE EYES

Something in the Eye. — We wash our faces and hands when they are soiled; we bathe our bodies. It is not so easy to cleanse our eyes; so, to a great extent, they must take care of themselves. If a cinder or a bit of dust flies into your eye, you feel a sharp pain, and very soon the tears are rolling down your face. They are washing away the cinder. Unless it is caught tightly in some corner, or under the lid, the pain will soon be over and the cinder gone. If the tears do not quickly wash it out, take hold of the upper lid and draw it gently over the lower lid; remain quiet for a few minutes, and the tears will probably wash it away. If the irritating substance is not removed by this means, a physician should be consulted.

Bathing the Eyes. — Never rub the eyes. If, when you first awake in the morning, you find it difficult to keep them open, wash the lids with cold water. If, for any reason, the eyes ache, instead of rubbing them close the lids, and hold the fingers lightly over the eyelids for a few minutes.

After bathing your eyes, or face, always use a fresh towel, or one that has been used only by yourself. There are serious diseases of the eye that may be carried on towels from one person to another.

Using the Eyes. — The eyes were made to use, and unless we abuse them, they will serve us well all our lives. We may use them until they begin to ache. Then they are tired and need rest. It is a good plan, when we are studying, to look away from the book every little while, fixing the eyes upon some object at a distance. The green of trees or grass is a restful color to the eyes. If you can look out of the window at a bit of green once in a while, your eyes will return to the fine print much refreshed.

We should never read by a flickering light nor in the twilight. We should not allow a bright light to shine on the book we are reading, or into the eyes. We should not read lying down or when reclining in a hammock. The head should be held erect for reading. Never look steadily at a bright light. It is especially harmful to look directly at the sun.

Near-sightedness. — Children who read a great deal have sometimes the misfortune to become near-sighted. This means that they cannot see clearly objects at a distance from their eyes. The trouble is usually caused *by holding the book too near the eyes or by leaning over a desk to study.* We should sit erect to study, holding the book fifteen inches away from the eyes. Can you clearly see the words in this book when the page is twenty inches from your eyes?

If your eyes pain you or you have headaches when you study, tell your teacher or your parents, so that they may find out whether there is anything the matter with them or not.

QUESTIONS

1. How are substances in the eye usually washed away?
2. What can you do to help to get a cinder, or other particle, out of the eye?
3. What should you do for your eyes instead of rubbing them?
4. How can you rest your eyes when they are tired from reading?
5. How should you sit when you are studying? How should you hold your book?
6. What may happen to your eyes if you forget to do this?

CHAPTER XXIX

TWELVE EVERYDAY HEALTH RULES

1. Rise early and go to bed early.
2. Eat good, nourishing food.
3. Drink plenty of clean, fresh water.
4. Let tobacco and alcoholic drinks alone.
5. "Work while you work," and work cheerfully.
6. "Play while you play," and play heartily.
7. Take *plenty* of out-of-door exercise, especially in winter.
8. Keep the lungs active by taking long breaths.
9. Exercise the skin by cold baths and rubbing.
10. Do not wear tight clothing of any kind.
11. Be sure that the rooms you live and sleep in are well ventilated.
12. Train yourself to be the skillful engineer of your body engine. Let your greatest ambition be to possess a strong, healthy, and graceful body.

GLOSSARY OF TERMS

Alcoholic drinks, beer, ale, wine, rum, whisky, brandy, etc.

Appetite, the desire for food.

Artery, the blood vessel, or tube, that takes the blood *away* from the heart.

Backbone, the string of twenty-six small bones running down the back and containing the *spinal cord*.

Bacteria, little living plants often found in uncooked food.

Ball-and-socket joints, joints that allow the bones to move in *any* direction.

Bicuspids, eight two-pointed teeth, four in each jaw, between the canines and the molars.

Bile, the fluid secreted by the liver.

Blood-heat, the ordinary temperature of the human body, or a little over 98° Fahrenheit.

Brain, the principal organ of the nerve system, located in the skull.

Breastbone, the bone just below the front of the neck.

Canines, four dog teeth, two in each jaw, next to the incisors.

Capillaries, the tiny blood vessels that connect the arteries with the veins.

Chest, the "box," or cavity, within the ribs, which holds the heart and lungs.

Chyle, the food after it has been digested in the small intestine.

Chyme, the food after it has been digested in the stomach.

Circulation, the movement of the blood through the body in the blood vessels.

Corpuscles, the little red and white bodies in the blood.

Diaphragm, a layer of soft muscle, forming the bottom of the chest.

Digestion, the changing of the food we eat into liquid form, so that it may be carried by the blood to the various parts of the body for nourishment.

Dislocation, the wrenching of a bone out of position at a joint.

Ear drum, the thin skin stretched across the tube of the ear.

Enamel, the outside covering of the teeth.

Esophagus, the tube through which food passes from the mouth to the stomach.

Exhaling, breathing *out*.

Fracture, a broken bone.

Gastric juice, a digestive liquid secreted by the stomach.

Heart, the organ in the center of the chest, a little to the left, which controls the flow of the blood.

Hinge joints, joints that allow the bones to be moved in but *one* direction.

Hygiene, the study of the way to take care of the body.

Incisors, the four front teeth of both the upper and lower jaw.

Inhaling, breathing *in*.

Intestine: *small intestine*, the tube into which food passes from the stomach; *large intestine*, the tube into which food passes from the small intestine, and out of which waste matter passes from the body.

Iris, the circle of color around the pupil of the eye.

Joint, the place where two bones come together.

Kidneys, two bean-shaped bodies which remove some of the waste materials from the body.

Larynx, or "*Adam's apple*," the enlarged part of the windpipe.

Ligaments, the bands of white fibers joining the bones together.

Liver, a very large organ, or gland, on the right side of the body, a little above the stomach.

Lungs, two organs in the chest, where the blood becomes purified.

Molars, twelve grinding teeth, six in each jaw, back of the bicuspids.

Mouth, the cavity containing the teeth and tongue.

Muscles, masses of lean flesh attached to the bones, by which the bones are able to move.

Narcotics, drugs that put the brain to sleep, such as opium, paregoric, alcohol, and tobacco.

Nerves, the white threads that extend from the brain all over the body.

Oxidizing, the burning of food in our bodies.

Oxygen, one of the gases found in air.

Pancreas, a thin gland just below the stomach.

Pancreatic fluid, the fluid secreted by the pancreas, which turns chyme into chyle.

Physiology, the study of the body and its works.

Pores, openings in the skin through which sweat passes.

Pulse, the throbbing caused by the movement of the blood.

Pupil, the black spot in the center of the iris of the eye.

Respiration, giving the body its proper supply of air and carrying off the waste gases.

Ribs, the twenty-four bones forming the sides of the chest.

Saliva, the moisture in the mouth that comes from the *salivary glands*. It helps digest food.

Salivary glands, little pockets or glands in the mouth, which secrete a digestive fluid.

Senses, touch, sight, hearing, taste, and smell.

Skeleton, the bony framework of the body.

Skull, the bony box which holds the brain.

Spinal cord, the part of the nerve system within the backbone.

Sprain, the tearing or straining of ligaments at a joint.

Stimulant, some kind of alcoholic drink overexciting a part or parts of the body.

Stomach, a kind of bag at the end of the esophagus, which receives the food, and where digestion is continued.

Taste buds, little bunches on the tongue to tell us whether food is pleasant or good to eat.

Tendo Achillis, the tendon at the heel.

Tendons, cords attaching the muscles to the bones.

Thirst, the desire for water.

Vein, the blood vessel, or tube, that brings the blood *back* to the heart.

Villi, little projections on the inner surface of the small intestine.

Windpipe, the tube through which air passes from the throat to the lungs.